DEPARTMENT OF
ENVIRONMENTAL QUALITY
Waste Management Division
Solid Waste Program
406/444-1430

FAX # (406) 444-1499

STATE OF MONTANA

OFFICE LOCATION: 2209 PHOENIX AVE. HELENA, MONTANA

MAILING ADDRESS: PO BOX 200901 HELENA, MT 59620-0901

July 5, 1995

James A. Flisrand
Director of Public Works
City of Laurel
P.O. Box 10
Laurel, Montana 59044

RE: **CITY OF LAUREL CLASS II LANDFILL (CLOSED), LICENSE NO. 203 NO-MIGRATION PETITION REVIEW**

Dear Mr. Flisrand:

Laurel has submitted a "no-migration petition" to the Department, the intent of which is to obtain a waiver of the normal ground water monitoring required at this facility. The Solid Waste Management Program has reviewed the submitted information in consideration of the request.

In the review process, the evaluation of representative hydraulic conductivity (K) values and rates of ground water flow has been difficult at this site. Even with the hydrogeologic data compiled from infiltrometer tests and slug tests conducted in the shallow ground water bearing zone(s) 17 feet below ground surface, enormous variabilities in vertical and horizontal migration rates have been encountered. This may be due to the fractured nature of the subsurface lithology (i.e., Niobrara/Colorado Shale), and the interconnectedness (i.e., secondary permeability) or the lack of interconnectedness between fractures and/or fracture systems in this formation. Calculated K values and migration rates are tenuous estimates at best, in this type of subsurface geologic media.

The submitted document concludes that the natural quality of the shallow ground water is poor and not worth monitoring for leachate constituents that may be emanating from the landfill. It also concludes that any aquifer of significant quantity and quality is at least 2,000 feet below ground surface in this area. As a result, there should be no risk to human health and the environment with regard to this deep aquifer within the 30-year post closure care period. In addition, the document determines that surface water seepages and surface waters in the immediate vicinity of the

landfill are naturally mineralized to such an extent as to deter any consumption or use.

The K values and the rates of migration calculated in the shallow ground water at this site, variable as they may be, demonstrate that, with approximately 2,000 feet of separation from the shallow ground water to the deep aquifer, migration rates would be insignificant with regard to environmental responsibilities for a 30 or even 40-year travel time.

Based on the information contained in the submittal, the City of Laurel is hereby granted a waiver of the groundwater monitoring requirements for City of Laurel Class II Landfill (closed) , License No. 203.

Thank you for your cooperation in this matter. Please do not hesitate to contact the program if you have any questions.

Sincerely,

Jon A. Dilliard

cc: The Garbage Committee for the City of Laurel, P.O. Box 10, MT 59044
Dr. George Sheckleton, Yellowstone County Health Officer, City-County Health Department, P.O. Box 35033, Billings, MT 59107
Chuck Rogers, Mayor, City of Laurel, P.O. Box 10, Laurel, MT 59044
Jason Campbell, Montana Department of State Lands, 1625 Eleventh Ave., Helena, MT 59620
Denise Martin, CECRA Program
Pat Dunlavy, Huntingdon, P.O. Box 4699, Helena, MT 59604

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file: Yellowstone Co./Laurel Class II (closed)/grd wtr (corr)

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Waste Management Division
Solid Waste Management Program
406/444-1430
FAX # (406) 444-1499
STATE OF MONTANA
OFFICE LOCATION: 2209 PHOENIX AVE. HELENA, MONTANA
MAILING ADDRESS: PO BOX 200901 HELENA, MT 59620-0901

February 23, 1995

Mr. James A. Flisrand
Director of Public Works
City of Laurel
P.O. Box 10
Laurel, Montana 59044

Subject: City of Laurel Landfill (License #203 - Closed)
Groundwater Monitoring

Dear Mr. Flisrand:

I would like to thank you, Mayor Rodgers, and Pat Dunlavy for taking the time to meet with representatives of the Department concerning the groundwater monitoring situation at the Laurel Landfill.

Based on my review of the information submitted with your letter of February 9th and further discussions of the situation with the staff of the Department's Water Quality Division, the Program will agree that the water bearing zone or uppermost groundwater being monitored at the Laurel Landfill is not the uppermost aquifer in and of itself. However, whether this water bearing zone is part of a group of formations that would constitute an aquifer of beneficial use remains to be determined.

Unfortunately, with the information currently on hand concerning the hydrogeology of the landfill and surrounding area, the Program cannot grant an approval for no-migration status for the landfill. Further information and documentation of the geological conditions will be necessary along with consideration of the impacted uppermost groundwater reaching a beneficial aquifer or discharging to surface water. Items such as the location of potential receiving aquifers, both horizontally and laterally, from the site and travel times to reach those aquifers or surface waters are important. Of special interest are the aquifers supplying the wells at or near the airport, the Beartooth and Groshelle Heights subdivisions, and the stock well southwest of the landfill and their extent and connection or interaction with the uppermost groundwater at the landfill. For your convenience and to help you with the type of information needed for a no-migration review, please refer to Administrative Rule 16.14.714.

From our meeting, it was my assumption that Pat Dunlavy would be your consultant on this issue. Pat is familiar with the Program and I encourage him to contact the program technical staff as needed for questions and assistance as he works on this project.

Thank you for your cooperation in this matter. Please do not hesitate to contact me if you have any questions.

Sincerely,

Jon A. Dilliard

cc: Chuck Rodgers, Mayor, City of Laurel, Box 10, Laurel, MT. 59044
Pat Dunlavy, Huntingdon, Box 4699, Helena, MT. 59604

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ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proof/RW DATE: 11/28/94

1. Pat C PPC

2. Jon D JD

3. Roger T RCT

- [x] Approval
- [ ] Comment
- [ ] Necessary Action
- [ ] Note and Return
- [ ] Note and File
- [ ] Investigate
- [ ] Prepare reply
- [ ] Signature
- [ ] See Me
- [ ] As requested
- [ ] For your information
- [ ] Per Conversation

REMARKS:

sw/yelllaur. rsp

FROM: P 3

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Waste Management Division
Solid Waste Program
406/444-1430
FAX # (406) 444-1499

STATE OF MONTANA

OFFICE LOCATION: 2209 PHOENIX AVE. HELENA, MONTANA
MAILING ADDRESS: PO BOX 200901 HELENA, MT 59620-0901

December 7, 1994

James A. Flisrand, Director of Public Works
City of Laurel
P.O. Box 10
Laurel, Montana 59044

RE: **CITY OF LAUREL CLASS II LANDFILL (CLOSED), YELLOWSTONE COUNTY - LICENSE NO. 203**
GROUND WATER - CONTINUED ASSESSMENT MONITORING

Dear Mr. Flisrand:

The State Solid Waste Program has recently been undergoing some regulatory adjustments in order to be able to interface more efficiently with the new (i.e., effective August 1994) Water Quality Standards (WQB-7) adopted by the Water Quality Division of the Department of Health and Environmental Sciences (DHES). This is the reason that the program and the Department has been slow in responding to your letters and requests for a meeting. We apologize for any inconvenience this delay may have caused. Existing solid waste ground water monitoring regulations have identified those solid waste facilities to be in Assessment Monitoring that have detected parameters and constituents from the Administrative Rules of Montana (ARM) 16.14.706 Table 1 list that are statistically significant above background levels, or that equal or exceed an enforcement standard.

In the case of the Laurel Landfill, this would apply to the nitrate concentrations consistently detected over 50 ppm [over the maximum contaminant level (MCL) of 10 ppm] in MW-2; as well as dichlorodifluoromethane (levels have increased from 4.3 ppb to 9.4 ppb), and trichlorofluoromethane (levels have increased from nondetect to 2.6 ppb) which were also detected in MW-2. Please note also that the chemical oxygen demand (COD) has always been relatively higher in MW-2, than any of the other wells.

Inorganic analytical results from the most recent sampling event (April 1994) also showed that the selenium concentration was above the MCL (0.05 ppm) in MW-2 (0.39 ppm), and slightly above the MCL in MW-4, the background well (0.08). A demonstration will be required to show that selenium is a naturally occurring metal in ground water

in this area, and that the values in the down gradient well MW-2 are from another source. References provided with Huntingdon's letter to you dated October 26, 1994 indicate this may be the case. The statistical analysis has not been presented to the Department, as required in the Administrative Rules of Montana (ARM) 16.14.706(12), (13), and (14).

With the adoption of WQB-7 by the Department in August 1994, human health standards as provided in WQB-7, will be enforced (if available) as enforcement standards and ground water protection standards (GWPS), if no MCLs have been promulgated according to ARM 16.20.203 and 204. Otherwise, an approved statistical test will be necessary to prove significance over background. To further clarify this issue, there are now three ways which will require the initiation of Assessment Monitoring:

1. A statistically significant increase above background concentrations, or a statistical increase or decrease in pH;

2. Equal or exceedence of an MCL or a ground water protection standard (GWPS); or

Additional Revised Interpretation:
3. Equal or exceedence of a human health standard (WQB-7), which is equivalent to a human health standard.

[Note: MCLs, and WQB-7 human health standards are currently considered to be enforcement standards, see ARM 16.14.702(17). Ground Water quality standards are determined according to ARM 16.20.1003. Ground water protection standards are established according to ARM 16.14.708(5)(a) through (c)].

Based on our analysis of the data dichlorodifluoromethane and trichlorofluoromethane are statistically significant over background, but have not become statistically significant over the human health standards according to WQB-7, which are 10,000 ppb for each constituent. Therefore, it will be necessary to continue monitoring the quality of the ground water at this facility according to the rules for continued Assessment Monitoring [see ARM 16.14.708(1)(a)(v) and ARM 16.14.708(3)].

Assessment Monitoring can be discontinued when concentrations of all Table 2 (ARM 16.14.706) constituents are shown to be at or below background values, using the statistical procedures in ARM 16.14.706(12), for two consecutive semi-annual sampling events. The owner or operator must notify the Department of this finding and may return to Detection Monitoring for Table 1 [ARM 16.14.706] constituents [see ARM 16.14.708(2)].

However, if a constituent concentration(s) is determined to be statistically significant above a MCL/GWPS or human health standard, then the following rule would be applicable:

> ARM 16.14.708(4) If one or more Table 2 (ARM 16.14.706) constituents are detected at statistically significant levels above the ground water protection standard established under ARM 16.14.708(5) of this rule in any sampling event, the owner or operator must, within 14 days of this finding, place a notice in the operating record identifying the Table 2 constituents that have exceeded the ground water protection standard and notify the Department and all appropriate local government officials. The owner operator will be required to initiate additional actions, one of which is a Corrective Measures Study [see ARM 16.14.708(4)(a)(iv)].

Please review the Department's responses provided below with regard to your statements concerning the following issues:

A. CLASSIFICATION OF GROUND WATER AND USAGE
At the Laurel Landfill, classification of the ground water at the background monitoring well (MW-4) is Class III ground water [ARM 16.20.100(2)(c)], as is the deeper down gradient monitoring well, MW-2D [ARM 16.20.1002(2)(d)]. All of the other monitoring wells are Class IV ground water and are located hydraulically down gradient from the landfill disposal area (i.e., MW-1, MW-2, and MW-3), indicating a poorer quality of ground water possibly due to impacts from the landfill. The elevated specific conductance values found in these hydraulically down gradient wells could serve as evidence supporting leakage into the ground water from the landfill disposal units.

It is in MW-2, the more proximal down gradient monitoring well location from the waste, that elevated nitrate concentrations and detectable levels of dichlorodifluoromethane and trichlorofluoromethane have also been found. Specifically, the presence of the volatile organic compounds (VOCs) (i.e., dichlorodifluoromethane and trichlorofluoromethane) add credence to the possibility of the landfill being the source of the impacted ground water hydraulically down gradient from the disposal areas.

According to ARM 16.20.1003(3),

> "The ground water quality standards have been established to protect the present and future most beneficial uses of the ground water, i.e., the highest classification level into which they may be placed based upon their existing quality or use on October 29, 1982".

At the Laurel Landfill site the highest classification is Class III ground water based on the quality of the ground water found in the background well MW-4 and the deeper down gradient monitoring well MW-2D, which have not suffered from the effects of the landfill activities. The Department has the responsibility to protect all aquifers, not just those currently used for drinking water.

B. HIGH NITRATE CONCENTRATIONS IN THE AREA

Elevated nitrate concentrations equal to, or exceeding the MCL have not been a problem with any of the other monitoring wells on-site at the Laurel Landfill, except in MW-2. Boring/lithology logs do not indicate any significant lithologic changes or variabilities in MW-2, and can be most closely correlated with the lithology found in MW-1. Both MW-2 and MW-1 encountered shallow ground water in the dark brown shale zone directly beneath the brown clay, and above the black shale. In MW-3, MW-4, and the deeper well, MW-2D, ground water was found in the black shale.

According to a table (VI-2, pg.VI-4; also see enclosure) found in the SWANA Course Manual for Manager of Landfill Operations Training Course, revised June 1991, entitled "Typical Leachate Characteristics", nitrate is considered to be a common constituent found in leachate. Nitrate values in leachate may range from 5 to 40 mg/L, with a typical concentration of 25 mg/L. Nitrate concentrations detected in MW-2 at the Laurel Landfill have been consistently greater than 50 mg/L since ground water sampling began on November 13, 1992. Unless additional demonstrations can be made at the site, the nitrate MCL exceedence of over 50 mg/L in MW-2 will still be considered to be associated with landfill leakage/leachate discharge from the disposal areas.

C. LANDFILL LEACHATE AND GAS GENERATION

Leachate/water mixing associated with leachate percolation is known to be a more efficient mechanism of contaminant transport into the ground water than landfill gas-to-water partitioning/phase transport. It is true that the VOCs, dichlorodifluoromethane and trichlorofluoromethane have high vapor pressures. With regard to ground water contamination, this means that a significantly greater gas concentration than water concentration is needed for equilibrium conditions; and even greater concentrations of gas are necessary for gas-to-water phase transport to occur at the water table.

Even if the source of the VOCs detected in the ground water to date at the Laurel Landfill are due to a gas-to-water phase transport mechanism, instead of leachate percolation into the ground water, the natural quality of the ground water is still being impacted by

the original landfill disposal activities and operations. Therefore, remediation of the source, be it landfill gas or landfill leachate, will still need to be sufficiently addressed to reduce VOC concentrations in the shallow ground water at this site, as well as the elevated nitrate concentrations, if the City ever hopes to return to Detection Monitoring.

D. REQUEST FOR NO MIGRATION PETITION APPROVAL

According to ARM 16.14.714(1), "Ground water monitoring at a facility may be waived by the Department if the facility owner or operator can demonstrate there is no potential for hazardous constitiuents to contaminate the uppermost aquifer." The Department does not agree with the conclusion that the uppermost aquifer is 2,000 feet below the landfill. The Department admits that the yield of the monitoring wells is low. However, the formation apparently is the source of the spring cited by Huntingdon and still meets the definition of an aquifer as found in ARM 16.14.702(4).

Taking into account the depth of the shallow ground water at this site [depth to water ranges from 17 feet below ground surface (BGS) at MW-1, to 27 feet BGS at MW-4, the background well], the depths of the disposal trenches, the fractured nature of the bedrock material in this area, and the apparent impacts to the shallow ground water presently beneath and emanating from this site, a no migration petition does not appear applicable to the hydrogeologic conditions at the Laurel Landfill.

CONCLUSIONS

Based on our analysis of the data from the Laurel Landfill and the requirements of the solid waste regulations, no assessment of corrective measures or any corrective action is required at this time. However, since monitoring constituents (nitrate, dichlorodifluoromethane, and trichlorofluoromethane) appear to be statistically significant above background, the Laurel Landfill will remain in assessment monitoring.

As a result, the Fall 1994 ground water sampling event should be conducted as soon as possible at this site. The event should include all 5 ground water monitoring wells at the site. Laboratory analysis will include all of the parameters/constituents on ARM 16.14.706 Table 1, plus dichlorodifluoromethane. According to ARM 16.14.708(1)(a)(v)(B), dichlorodifluoromethane will be included as part of the continued Assessment Monitoring constituent list.

For future reference, in continued Assessment Monitoring, a facility is required to sample all wells no less than once per year for the entire Table 2 list of parameters and constituents; unless an

adequate demonstration can be made for those particular constituents that are determined not to have been part of the waste source. This demonstration could best be accomplished by collecting the landfill leachate and analyzing it for its various inorganic and organic components, as required for analysis under Table 2 ARM 16.14.706. Another approach, if leachate collection is impractical, would be to install a boring/well into the waste to determine if, in fact:

1) leachate is being generated at the site, and
2) what are the components of that leachate, if present.

If you have any questions, give me call.

Sincerely,

Jon Dilliard
Program Manager

enclosure - "Typical Leachate Characteristics"

cc: Chuck Rodgers, Mayor

Pat Dunlavy, Huntingdon, Box 4699, Helena, MT 59604

Dr. George Sheckleton, Yellowstone County Health Officer, City-County Health Department, P.O. Box 35033, Billings, MT 59107

Jason Campbell, Department of State Lands

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Table VI-2

TYPICAL LEACHATE CHARACTERISTICS		
CONSTITUENT	Value mg/l	
	Range	Typical
BOD (5-day biochemical oxygen demand)	2,000-30,000	10,000
TOC (total organic carbon)	1,500-20,000	6,000
COD (chemical oxygen demand)	3,000-45,000	18,000
Total suspended solids	200-1,000	500
Organic nitrogen	10-600	200
Ammonia nitrogen	10-800	200
Nitrate	5-40	25
Total phosphorus	1-70	30
Ortho phosphorus	1-50	20
Alkalinity as $CaCO_3$	1,000-10,000	3,000
pH	5.3-8.5	6
Total hardness as $CaCO_3$	300-10,000	3,500
Calcium (Ca)	200-3,000	1,000
Magnesium (Mg)	50-1,500	250
Potassium (K)	200-2,000	300
Sodium (Na)	200-2,000	500
Chloride (Cl)	100-3,000	500
Sulfate (SO_4)	100-1,500	300
Total Iron (Fe)	50-600	60

Several of these constituents are of particular note:

- Biochemical Oxygen Demand (BOD) - a common analysis to determine organic content of a waste. As an example of the strength of the leachate, domestic sewage has a BOD of approximately 500 mg.

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES

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STATE OF MONTANA

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Solid and Hazardous Waste Bureau
(406) 444-1430

MEMORANDUM

TO: Pat Crowley

FROM: Pat Potts

DATE: October 12, 1994

SUBJECT: Laurel Landfill

It is important to point out the timeframes involving the enforcement of the Corrective Measures Study with regard to the new Water Quality standards (i.e. WQB-7, dated July 15, 1994; effective August, 1994):

1. Assessment Monitoring - samples April 22, 1994
2. Assessment Monitoring analytical results received by the facility/consultant on June 13, 1994
3. Dept. received analytical results - June 28, 1994
4. Dept. responded with guidance letter concerning the Corrective Measures Study and implementation - July 20, 1994

It is difficult to understand how the new standards (WQB-7, eff. 8/94) can be can be applied retroactively, when the Corrective Measures Phase was already determined based on the results that were received by the Dept on June 28, 1994. Enforcement of the Corrective Measure phase was determined in accordance with the standards that were in existance at the time of the receipt of the results (i.e., Federal MCLs).

Must I have a crystal ball to tell me what the standards will be in order to evaluate analytical results in the future, so that this situation does not arise again. Should I notify all of those facilities currently undergoing the Corrective Measures Studies that the standards have changed, and now they don't have to do anything to clean-up contamination we already know is present in the ground water and in most cases, is migrating off-site and off-property?

Specifically,
In this case concerning the Laurel Landfill, dichlorodifluoromethane was analyzed in all past sampling events (4) at concentrations that should have been determined to be statistically significant above background by the owner/operator. This was not necessary, because the MCL exceedence of nitrate was sufficient to initiate Assessment Monitoring.

A Corrective Measures Study was to be initiated based on the concentration of dichlorodifluoromethane from the Assessment Monitoring event (sampled April, 1994 and analysis received June, 1994). No MCL was available for dichlorodifluoromethane prior to the Human Health Standard given in WQB-7 which was dated July 15, 1994, and may not have become effective until August 1994. Therefore, according to ARM 16.14.708(5)(b), when no ground water protection standard has been promulgated, the background concentration for the constituent is the ground water protection standard; and the exceedence of an enforcement standard initiates the Corrective Measures Study [see ARM 16.14.708(4) and (4)(a)(iv)]. This would be applicable to dichlorodifluoromethane until at least July 15, 1994, and probably until August 1994 when the rule became effective.

I would appreciate your response on this issue, for applicability concerning other sites in similar situations (i.e., Stillwater Co./Columbus, Scratchgravel, Unified Disposal, Polson/Lake Co., City/County Sanitation).

p^3

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FILE Copy:
YELLOWSTONE Co,
Laurel (II) closed
grd wtr (corr)

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Waste Management Division
Solid Waste Program
406/444-1430

FAX # (406) 444-1499

STATE OF MONTANA

OFFICE LOCATION: 2209 PHOENIX AVE. HELENA, MONTANA

MAILING ADDRESS: PO BOX 200901 HELENA, MT 59620-0901

July 20, 1994

Dave Michael
City of Laurel
P.O. Box 10
Laurel, Montana 59044

RE: **CITY OF LAUREL CLASS II LANDFILL (CLOSED) - LICENSE NO. 203**
GROUND WATER - CORRECTIVE MEASURES

Dear Mr. Michael:

A facility facing ground water corrective measures activities should carefully evaluate the quality and quantity of the hydrogeologic information; and specifically, the ground water (hydrologic) data that has been accumulated to date at the site, to determine:

1. If the entire active and inactive licensed disposal areas have been adequately investigated and a sufficient number of borings and monitoring wells have been installed at the site;

2. If pre-existing data sources in the area have been investigated and evaluated, such as aerial photos, geophysical surveys, stratigraphic boreholes, piezometers, head measurements, in-situ hydraulic conductivity tests, and/or laboratory analyses of ground water samples or surface water samples collected in the area;

3. If the data from the site is consistent, or are there trend(s) or gaps in the data;

   a. Is the hydrogeology similar across the site? More complex sites require more borings, wells, etc.

   b. Are the ground water analytical results repeatable and consistent over time (at least 2 to 4 years)?

   c. Have sufficient samples been taken to provide a statistical basis for comparison?

4. Whether the contamination found in the ground water is confined to a hot spot or margin beneath the facility property, and/or beneath an adjacent property;

5. If the contamination in the ground water has migrated off-site;

6. What are the parameters/constituents of concern (i.e., driver constituents). How high are the concentrations of these constituents in the ground water? Have maximum contaminant levels (MCLs) been established for these constituents? Are they carcinogens, or toxins?

7. Is the aquifer presently being monitored a drinking water source, locally or regionally? If so, where are the receptors located in relation to the landfill site? If not, how close is the ground water-bearing zone(s) or aquifer(s) presently being monitored at the facility to a drinking water aquifer or supply source, geologically (i.e., separation in depth from ground surface to aquifer, vertically downward).

From the above information:

What are the risks to human health and the environment?

Could an alternate ground water protection standard be determined that is protective of human health and the environment?

What methods of remediation can reduce the known contaminant concentrations in the ground water sufficiently to meet the established ground water protection standards and/or background concentrations, and what are the economics associated with the proposed remedial measures?

If a potential hazard to the public is proven to be negligible, a costly program of remediation may be demonstrated to be unnecessary in some cases. If there is a potential that the public health could be significantly endangered at a site, a risk assessment (RA) must be employed to determine the appropriate levels of clean-up required to bring the risks within acceptable levels. Hazardous substance health risks can be categorized into two primary concerns:

a. The inherent toxicity of the contaminant, and

b. The degree of exposure experienced by the public.

Has this facility already initiated the required upgrades to the operational procedures which may also address in-part the corrective measures remedies? Some of the operational requirements that have already been observed to help improve the quality of the ground water at an impacted landfill site are:

I. The installation of a low permeability cover/cap over the inactive/closed disposal areas to reduce/eliminate infiltration of surface water/precipitation into the waste;

II. Establish a vegetative layer over the cover/cap to help eliminate runoff, and reduce infiltration; and

III. Install a passive and/or active gas venting system, as determined from methane monitoring results at the facility.

If your facility has implemented some or all of these upgrades, have you seen reduced concentrations of contaminants in the ground water? At what rate, since the above actions/measures were implemented?

The Department requires an adequate and accurate site characterization of the soils and hydrogeology be provided at each site; however, some facilities may be in a situation where natural geologic and hydrologic complexities compound the ground water contamination problem already known to exist at the site. Source removal, and/or reduction, is generally not a feasible solution. Stabilization or containment may abate problems posed by contaminant migration in the ground water. Most sites with ground water contamination must look at long-term operations and objectives, with present and potential risks to human health and the environment factored into any proposed remediation effort. It is important to understand the conditions of the ground water at the facility, the associated risks to human health and the environment, and the economically and technologically feasible approaches available under the known/existing conditions at the site.

The enclosed summary of the corrective measures portion of the ARM 16.14.708 regulation will hopefully be more user-friendly than the regulations themselves. Note that this summary is organized in a more orderly, successive series of events. Regulatory citations are provided for your reference.

Sincerely,

Pat Potts
Environmental Specialist

cc: Chuck Rogers, Mayor, City of Laurel, P.O. Box 10, Laurel, MT 59044

Jim Shaffer, GeoResearch, Inc., 115 North Broadway, Billings, MT 59101

ASSESSMENT MONITORING RESULTS

After a solid waste facility has initiated the Assessment Ground Water Monitoring Phase [initial sampling according to Table 2 (ARM 16.14.706], due to parameter/constituent exceedences equal to or above an enforcement standard/ground water protection standard (MCLs), or when concentrations which are shown to be statistically significant over background (within the required 90-day period following this exceedence discovery), one of the following circumstances will become apparent from the site-specific analytical results of the Table 2 sampling:

708(2) Concentrations of all Table 2* constituents are at or statistically below background values for 2 consecutive sampling events;

708(3) Concentrations of any Table 2* constituents are statistically above background values, but all concentrations are below the ground water protection standards (MCLs)/enforcement standards; or

708(4) Concentrations of one or more Table 2* constituents are detected at statistically significant levels above the ground water protection standards (MCLs)/enforcement standards.

If 708(2), then the facility may return to Detection Monitoring (i.e., sampling for Table 1 [ARM 16.14.706]).

If 708(3), then the facility will remain/continue in Assessment Monitoring.

* Refers to both Table 1 and Table 2 (ARM 16.14.706) parameters/constituents, as Table 2 is inclusive of most parameters/constituents on Table 1.

CORRECTIVE MEASURES ASSESSMENT (CMA)

However, if 708(4) is true and an exceedence has occurred, then the facility is required to:

16.14.708(4)(a)(i)	Install additional monitoring wells, as needed, to characterize the nature and extent of the release,
708(4)(a)(ii)	Install at least 1 additional monitoring well at the hydraulically down gradient facility property boundary,
708(4)(a)(iii)	Notify all persons who own the land or reside on the land that directly overlies the plume, and
708(4)(a)(iv)	Initiate an "assessment of corrective measures", within 90 days from the discovery/receipt of the analytical results from the Table 2 ground water analysis (i.e., the initial Assessment Monitoring event). The assessment is to be completed within an additional 60 days (i.e., 150 days total time allowed for assessment of corrective measures, from the date of the receipt of the analytical results from the initial Table 2 sampling event) for submittal to the Department [ARM 16.14.708(6)(a)].

The Corrective Measures Assessment (CMA) is Required to Include the Following:

16.14.708(6)(c)	Analysis of the effectiveness of potential corrective measures, (Requirements and objectives of each remedy under consideration.)

708(6)(c)(i) For each remedy proposed, evaluate the following:
- Performance
- Reliability
- Ease of implementation
- Potential impacts - safety,
  cross-media,
  control exposure to any residual contamination.

708(6)(c)(ii) Time-frames - initiate remedy (i.e., operational)
estimated completion of remedy

708(6)(c)(iii) Costs - based on site-specific contaminants, concentrations, and media volumes.

708(6)(c)(iv) Additional requirements - State and/or local permit requirements, or other environmental or public health requirements that may affect implementation of each remedy suggested.

A report will be required by the Department addressing all of the above issues for each remedy considered [ARM 16.14.716(1)].

708(6)(d) The results arrived at from the CMA are required to be discussed in a PUBLIC MEETING with interested and affected parties prior to final remedy selection.

CORRECTIVE MEASURES REMEDY SELECTION

From the results of the corrective measures assessment (CMA) and the accompanying report submittal to the Department, the owner/operator is required to select a remedy based on the results of the CMA, and to notify the Department within at least 14 days from the date of the selection. This remedy must meet the following standards [ARM 16.14.708(7)(a)]:

708(7)(b)(i)	Protective of human health and the environment,
708(7)(b)(ii)	Attain the ground water protection standard, or the alternate ground water protection standard,
708(7)(b)(iii)	Control source(s) - reduce or eliminate releases,
708(7)(b)(iv)	Comply with the "Standards for Management of Wastes", which requires a schedule for "Initiating and Completing Remedial Activities". The schedule should consider the following factors:
708(7)(d)	Schedule - "Initiating and completing remedial activities" should consider the following factors:
708(7)(d)(i)	Extent and nature of contamination,
708(7)(d)(ii)	Practical capabilities of remedial technologies in achieving compliance with ground water protection standards,
708(7)(d)(iii)	Treatment or disposal capacity for wastes,
708(7)(d)(iv)	Utilization of unavailable technologies (i.e., future technologies), and

708(7)(d)(v)	Risks to human health and the environment:
708(7)(d)(vi)	Resource value of the aquifer,
708(7)(d)(vi)(A)	Current and future uses,
708(7)(d)(vi)(B)	Proximity and withdrawal rate of users,
708(7)(d)(vi)(C)	Ground water quantity and quality,
708(7)(d)(vi)(D)	Potential damage due to exposure to wildlife, crops, vegetation, and physical structures,
708(7)(d)(vi)(E)	Hydrogeologic characteristic of the facility and the surrounding land,
708(7)(d)(vi)(F)	Ground water removal and treatment costs, and
708(7)(d)(vi)(G)	Cost and availability of alternate water supplies.
708(7)(d)(vii)	Practical capability of the owner/operator.
708(7)(d)(viii)	Other relevant factors.
708(8)(a)	The schedule for "Initiating and Completing Remedial Activities" requires the owner/operator to provide:
708(8)(a)(i)	Corrective action ground water monitoring program:
708(8)(a)(i)(A)	At least as inclusive as the Assessment Monitoring program,
708(8)(a)(i)(B)	Demonstrates the effectiveness of the corrective action remedy, and

708(8)(a)(i)(C)	Demonstrates compliance with the ground water protection standards.
708(8)(a)(ii)	Implementation of corrective action remedy selected.
708(8)(a)(iii)	Possible interim measures to ensure the protection of human health and the environment.
708(8)(b)	Evaluation of compliance achieved (or not achieved) through the remedy selected. If not, owner/operator is required to select another remedy or technique, OR
708(8)(c)	Determine that compliance cannot be practically achieved with any currently available methods by:
708(8)(c)(i)	Obtain certification from a qualified ground water scientist and approval by the Department that compliance cannot be achieved,
708(8)(c)(ii)	Implement alternative measures to control exposure, and protect human health and the environment,
708(8)(c)(iii)	Implement alternative measures for the control of sources of contamination, etc. as is:
708(8)(c)(iii)(A)	Technically practicable,
708(8)(c)(iii)(B)	Consistent with remedial objective(s), and

708(8)(c)(iv) Submit a report to the Department 14 days prior to the implementation of the alternative measures. This report should include an evaluation of all remedies considered, as well as the NO ACTION alternative [ARM 16.14.716(1)] if this information has not been thoroughly addressed in the CMA report.

708(7)(b)(v) Approved by the Department.

708(7)(c) Remedy(ies) "evaluation factors":

708(7)(c)(i) Effectiveness and protectiveness (short- and long-term), as well as the degree of certainty that the remedy(ies) will be successful considering:

708(7)(c)(i)(A) Magnitude of reduction of existing risk,

708(7)(c)(i)(B) Magnitude of residual risks,

708(7)(c)(i)(C) Long-term management required (monitoring, operation, and maintenance,

708(7)(c)(i)(D) Short-term risks (community, workers, or the environment),

708(7)(c)(i)(E) Time until full protection achieved,

708(7)(c)(i)(F) Potential for exposure (human and environmental),

708(7)(c)(i)(G) Long-term reliability, and

708(7)(c)(i)(H) Potential need for replacement of the remedy.

708(7)(c)(ii) Effectiveness of the remedy in controlling the source based on the following factors:

708(7)(c)(ii)(A) Containment practices usage, and

708(7)(c)(ii)(B) Treatment technology use.

708(7)(c)(iii) Implementation of a potential remedy(ies) - ease or difficulty.

708(7)(c)(iii)(A) Construction technology,

708(7)(c)(iii)(B) Operational reliability,

708(7)(c)(iii)(C) Approvals and permits from other agencies,

708(7)(c)(iii)(D) Availability of equipment and specialists, and

708(7)(c)(iii)(E) Available capacity and location of needed treatment.

708(7)(c)(iv) Technical and economic capability of the owner/operator.

708(7)(c)(v) Address community concerns with relation to potential remedy(ies).

708(7)(e) The Department may determine that remediation of a release is not necessary if the owner/operator demonstrates that:

708(7)(e)(i) There is additional contamination of the ground water from a source other than the landfill, and clean-up of the landfill associated contamination would not reduce risks to actual or potential receptors, OR

708(7)(e)(ii) The ground water is:

708(7)(e)(ii)(A) Not currently or reasonably expected to be a source of drinking water, and

708(7)(e)(ii)(B) Not hydraulically connected, or will not migrate in concentrations exceeding the ground water protection standards, OR

708(7)(e)(iii) Remediation is technically impractical, OR

708(7)(e)(iv) Remediation results in unacceptable cross-media impacts.

708(7)(f) The State will still maintain the authority to require the owner/operator to undertake source control measures or other measures to eliminate or minimize further releases to the ground water, to prevent exposure to the ground water, or to remediate the ground water to concentrations that are technically practical and significantly reduce threats to human health and the environment.

Yellowstone (closed)

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Prof CU DATE: 4/4/94

1. Jon D. JD

2. Roger T. RT

3.

☑ Approval	☐ Comment	☐ Necessary Action
☐ Note and Return	☐ Note and File	☐ Investigate
☐ Prepare reply	☐ Signature	☐ See Me
☐ As requested	☐ For your information	☐ Per Conversation

REMARKS:

sw/yelllaur.def

mailed 4-6-94 lm

FROM: 3

Laura,

When my (p^3) "Laurel" letter gets routed, please blind cc:

Jennifer Draper
% Laurel Outlook
P.O. 278
Laurel, MT 59044

DEPARTI
HEALTH AND ENVIRO

STAN STEPHENS, GOVERNOR

STATE OF M

OFFICE LOCATION: 836 Front Street
Helena, Montana

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
MARC RACICOT, GOVERNOR 406/444-1430
FAX # (406) 444-1499
STATE OF MONTANA
OFFICE LOCATION 836 Front Street Helena, Montana
MAILING ADDRESS: PO BOX 200901 Helena, MT 59620-0901

April 5, 1994

David Michael
City of Laurel
P.O. Box 10
Laurel, Montana 59044

RE: **CITY OF LAUREL CLASS II LANDFILL (CLOSED), YELLOWSTONE COUNTY - LICENSE NO. 203**
ASSESSMENT MONITORING

Dear Mr. Michael:

On March 30, 1994 the Montana Department of Health and Environmental Sciences, Solid Waste Program (the Department) received a letter from Mr. James Shaffer, senior hydrogeologist for GeoResearch, Inc. requesting a deferral and temporary waiver of Assessment Monitoring at the Laurel Class II Landfill (License No. 203). The Department cannot defer or temporarily waive regulatory ground water monitoring requirements, particularly when parameter(s)/constituent(s) concentrations are determined to:

* Equal, or exceed established enforcement standards/Ground Water Protection Standards(GWPSs)/maximum contaminant levels (MCLs), and/or

* Be statistically significant above background levels, for those constituents for which no MCL has been established.

Over the 3 semi-annual ground water sampling events that have been conducted at the Laurel Landfill site beginning in November 1992:

* Nitrate (as nitrogen) concentrations in monitoring well MW-2 have ranged from a low of 51.0 ppm (5/3/93 - duplicate), to a high of 55.4 ppm (9/10/93 - replicate). The MCL for nitrate is 10 ppm, and

* VOCs have been steadily increasing in number, possibly in relationship to the molecular weight of the compound, also affecting its rate of transport in the ground water.

November 1992	May 1993	September 1993
dichlorodifluoro-methane (CFC-12)	dichlorodifluoro-methane	dichlorodifluoro-methane
methylene chloride	methylene chloride	methylene chloride
	trichlorofluoro-methane (CFC-11)	trichlorofluoro-methane
		1,1,1-trichloro-ethane

Based on the above impacts to the natural quality of the shallow ground water at this site, the Department will require all monitoring wells at the Laurel landfill site to be sampled for the Administrative Rules of Montana (ARM) 16.14.706 Table 2 list of required parameters/constituents, as well as those parameters in Table 1 that are not included in the Table 2 list. By exceeding the 90-day deadline (i.e., April 1, 1994) for this Assessment Monitoring requirement, sampling for Table 2 and the additionally required parameter(s)/constituents(s) should be conducted promptly after receiving this letter, to avoid violation of State regulations. Due to the timing of this Assessment Monitoring sampling event, the Department will consider this sampling event as fulfillment for the Spring 1994 semi-annual ground water sampling requirement.

The Department strongly suggests that ammonia (as nitrogen) be included as an additional analyte for this and all future ground water sampling events. The current ARM 16.14.706 Table 1 list of constituents does not require the analysis for ammonia. However, at the Laurel Class II Landfill site where nitrogen has been found in concentrations over the MCL, the analysis of the ground water for the ammonia parameter may prove to be beneficial in determining reducing and oxidizing conditions occurring in the ground water beneath the landfill. It appears that ground water immediately associated with solid waste disposal areas (in certain parts of the State) reflect a high ammonia concentration in conjunction with a low nitrate concentration, possibly indicating the reducing affects of leachate initially impacting the ground water at the more hydraulically upgradient locations. Whereas, the ammonia concentrations have been observed to be low where nitrate concentrations are elevated. In areas where no immediate interaction with leachate and the ground water is possible, such as the hydraulically upgradient/background well, both nitrates and ammonia concentrations are relatively low. From these types of observations, it may be possible to delineate pathways of contaminant migration and/or chemical alterations occurring from a

reducing to an oxidizing environment in the ground water. The additional cost for the requested ammonia analysis is approximately $7.50 per sample (i.e., per well).

As mentioned earlier, the chloride concentrations detected in MW-1 also warrant close observation. Chloride readily dissolves in the ground water and is quite mobil under normal conditions. Therefore, elevated concentrations of chloride can be an indicator of slower moving (heavier molecular compounds) yet to be transported far enough hydraulically down gradient to be intercepted and monitored at the particular well location. It is always helpful to attempt to understand the natural ground water chemistry at a site, in anticipation of any abnormal impacts.

The request for drilling and installation of 2 additional hydraulically upgradient shallow ground water monitoring wells (i.e., 94MW-6 and 94MW-7) is agreeable to the Department, although these wells do not directly address the hydraulically down gradient delineation or the extent of the plume(s). Please consider that if Laurel is adamantly concerned about distinguishing the difference from contaminant constituents and concentrations possibly emanating from the older landfilled area (License No. 24), as compared to contaminant constituents and concentrations detected in the shallow ground water down gradient from the closed landfill (License No. 203), any contamination discovered in the ground water emanating from beneath the older landfill site would still be required to be remediated, according to State CECRA authority, not the Department's Solid Waste Program.

Please be advised that the laboratory analytical results from the required overdue Assessment Monitoring event are to be submitted to the Department within 14 days from the receipt of the analytical results by the owner/operator or their technical consultant, assuming an MCL has been reached or exceeded, or there is a statistically significant increase above background for any constituent(s) not having an established MCL. If you have any questions, please give me a call.

Sincerely,

Pat Potts

Pat Potts
Environmental Specialist

cc: James Shaffer, Senior Hydrogeologist, GeoReSearch, Inc., 115 N. Broadway, Billings, MT 59101

The Garbage Committee for the City of Laurel, P.O. Box 10, MT 59044

Dr. George Sheckleton, Yellowstone County Health Officer, City-County Health Department, P.O. Box 35033, Billings, MT 59107

Chuck Rogers, Mayor, City of Laurel, P.O. Box 10, Laurel, MT 59044

Kevin Chappell, Surface Management Bureau, Montana Department of State Lands, 1625 Eleventh Ave., Helena, MT 59620

Denise Martin, CECRA Program

path: sw\yelllaur.def
file: yellowstone co./laurel II (closed)/grd wtr (corr)

File: Yellowstone Co
Laurel (I) - closed
grd wtr (corr)

GEORESEARCH, INC.

RECEIVED
MAR 30 1994
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

March 29, 1994

Ms. Pat Potts
Environmental Specialist
Montana Dept. of Health
and Environmental Sciences
Solid Waste Program
P. O. Box 200901
Helena, MT 59620-0901

Re: Request for Deferral and Temporary Waiver of Assessment Monitoring at Laurel Landfill, MT (License No. 203)

Dear Ms. Potts:

Concerning your letter dated February 1, 1994, (see also our letter dated February 10) the City of Laurel is required to implement assessment monitoring at the subject landfill. In accordance with the pre-October 1993 solid waste regulations which you stated are applicable to this site, resampling of the five network monitoring wells was to be conducted by April 1, 1994. Lab testing was to have been for ARM 16.14.706 Table II constituents plus eight inorganic parameters, as specified.

On behalf of our client, the City of Laurel respectively requests that in lieu of the assessment monitoring, it be deferred temporarily pending the results to be obtained from additional site characterization activities which are planned during early April, 1994. A brief report of the results of the activities to supplement the Hydrogeologic and Soils Study (February 9, 1994) would be delivered to the Montana Solid Waste Program (MSWP) within five weeks of additional well installation and sampling which are planned. This timing is sufficiently scheduled to permit the evaluation of results by the MSWP in time for the semi-annual sampling event which would occur normally in May 1994. This frequency/date was established as a result of the November 92 and May 93 sampling events. It is understood that the MSWP has the authority to increase or decrease the sampling frequency and testing parameters based on the evaluation of site conditions or risks.

As a result of the information concerning the prior use of the upgradient lands, i.e., as a pig farm and the disposal, use, and possible runoff of dried treated sewage sludge as a soil amendment on closed landfill license 24, questions have been raised as to the source of nitrates observed in groundwater at MW-2. These practices bring into question the practicality of MW-4 as a valid background well for all of landfill license 203, and specifically MW-2.

115 North Broadway
Billings, MT 59101
TEL. (406) 248-6771
FAX (406) 248-6770

Alternatively to implementation of the pre-October 1993 regulations, i.e., subsections ARM 16.14.708(a), (b), and (c), MSWP could have required -708(d) and (e), that is, installation of additional wells to further define the nature and extent of contamination and for correction action planning and impact assessment. At this time, the City believes the latter approach to be more appropriate given previous site history and unknowns.

The City of Laurel proposes to MSWP to contract with GeoResearch to install two additional groundwater monitoring wells (wells 94MW-6 and 94MW-7) at the locations indicated on the attached map. Soil samples would be collected and analyzed for nitrates on 10-foot intervals from the surface, or any waste to the depth of groundwater. Groundwater samples from each of the new wells would be analyzed for the Table I list plus the eight parameters listed in your February 1 letter. Only these two wells installed at this time would be tested as described above. The existing approved work plan, dated September 2, 1992, as amended by subsequent MSWP comments (dated October 26, 1992), including the well construction and sampling procedures contained, would be used for this activity. Laboratory testing would be on a normal three-week turnaround basis with evaluation and reporting of the results to MSWP within two weeks, as required by regulation. The report would supplement the February 1994 Hydrogeologic report; it would be confined to site hydrogeology, soil and groundwater quality, comparison with existing analytical data, and recommendations.

The location of the drilling sites was selected in anticipation that the results will:

- provide accurate determination of the groundwater quality upgradient of well MW-2 coming from beneath landfill license No. 24,
- provide information concerning potential off-site upgradient and lateral sources/receptor, extent and magnitude of contamination,
- assess potential nitrate levels and leachate in soils above groundwater,
- analyze groundwater samples from the two wells for Table I constituents to provide results and parameters consistent with existing data at the site,
- provide additional characterization of groundwater flow, fracture occurrence, and groundwater quality data for the selected parameters.

It is requested that MSWP will provide written approval of the planned drilling and sampling actions. We will address and consider any comments or suggestions which MSWP may have concerning the procedures, scope, and timing of the planned activities. It is also requested that MSWP defer until mid-May 1994 the existing requirement for resampling and conducting assessment monitoring on all network wells at this closed landfill. In expectation of your approval and because time is of the essence, we plan to proceed with land use arrangements with Montana DSL and contracting and scheduling drilling services for early April. However, no drilling, well sampling, including that for the required assessment monitoring, or laboratory testing will commence until acknowledgement and response to this request have been received from MSWP.

Again, the subject deferral is requested for a period not to exceed May 30, 1994, and pending instructions from MSWP following its review of the report for this planned investigation at the Laurel landfill. Thank you for your cooperation. If you have any questions, please do not hesitate to contact me.

Sincerely,

James D. Shaffer

James D. Shaffer
Sr. Hydrogeologist

atch: Figure 3-6 (planned wells 94MW-6 and 94MW-7)

cc: C. Rodgers, Mayor, City of Laurel
D. Michael, City of Laurel

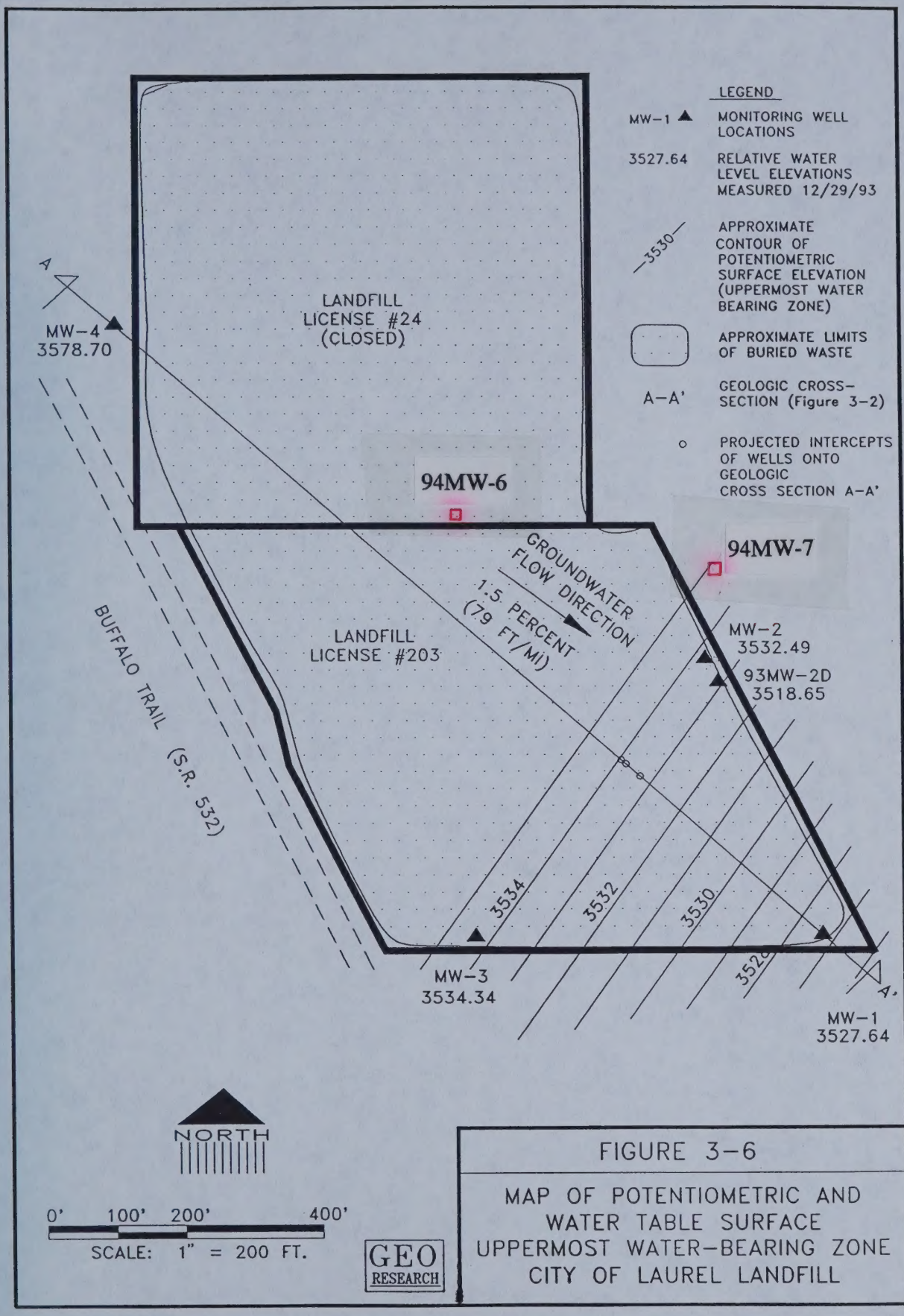

FIGURE 3-6

MAP OF POTENTIOMETRIC AND WATER TABLE SURFACE UPPERMOST WATER-BEARING ZONE CITY OF LAUREL LANDFILL

FIGURE 3-8

MAP OF POTENTIOMETRIC AND
WATER TABLE SURFACE
UPPERMOST WATER-BEARING ZONE
CITY OF LAUREL LANDFILL

Yellowstone

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proof CJ DATE: 1/31/94

1. Pat C. PPC

2. Jon D. JD

3. Roger T. RCT

- [x] Approval
- [ ] Comment
- [ ] Necessary Action
- [ ] Note and Return
- [ ] Note and File
- [ ] Investigate
- [ ] Prepare reply
- [ ] Signature
- [ ] See Me
- [ ] As requested
- [ ] For your information
- [ ] Per Conversation

REMARKS:

sw/ laurel.asm

FROM: P 3

mailed 2-1-94 lh

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
MARC RACICOT, GOVERNOR 406/444-1430
FAX # (406) 444-1499
STATE OF MONTANA
OFFICE LOCATION 836 Front Street Helena, Montana
MAILING ADDRESS: PO BOX 200901 Helena, MT 59620-0901

February 1, 1994

Public Works Director
City of Laurel
P.O. Box 10
Laurel, Montana 59044

RE: **CITY OF LAUREL CLASS II LANDFILL (CLOSED), YELLOWSTONE COUNTY - LICENSE NO. 203**
REVIEW OF FALL 1993 GROUND WATER SAMPLING AND ANALYTICAL RESULTS.

Dear Director:

Upon review of the ground water analytical data from the September 1993 sampling event at the City of Laurel Class II Landfill, it is quite obvious that the concentration of nitrates as N (nitrogen) in MW-2 has exceeded the US EPA and State regulatory maximum contaminant levels (MCLs) by greater than 5 times (54.2 mg/L) the MCL established for nitrates as N, which is 10 mg/L. In May 1993, the concentration of nitrates as N in MW-2 was detected at 52.4 mg/L. This has been an ongoing problem and must be addressed in accordance with the Administrative Rules of Montana (ARM).

The previously applicable State regulations which addressed the "Definition of the Extent of Contamination [ARM 16.14.708(1)] states that when an enforcement standard and/or a preventative action limit is exceeded the Department may require one or more of the following actions be taken by the owner or operator:

* (a) Re-sample one or more of the monitoring wells,
* (b) Increase the frequency of ground water sampling,
* (c) Conduct monitoring for additional parameters,
(d) Install additional monitoring wells to define the nature and extent of contamination, or
(e) Prepare a ground water corrective action plan including an assessment of the impacts and a schedule of implementation for corrective action.

Prompt implementation of the above-asterisked items (i.e., a, b, and c) will be required. The City of Laurel will have **60 calendar-days** from the date of this letter to re-sample all of the monitoring wells in the ground water monitoring network which includes (MW-1, MW-2, MW-3, MW-4 and 93MW-2). All of the wells will be sampled for ARM 16.14.706 Table II (effective 10/9/93) constituents, as well as the following additional inorganic parameters: **chloride, iron, nitrate (as N), sulfate, chemical oxygen demand (COD), pH, temperature (field & lab), and specific conductance**. This required sampling event places the facility in the Assessment Monitoring Phase in the recently promulgated State regulations [i.e., ARM 16.14.708(1)(a)(ii)].

From the ground water analytical data provided at this site to date, it is also important to note that the concentration of several metals are dangerously near the established MCLs. The Department is also painfully aware that the volatile organic compounds (VOCs) originally detected in the initial sampling events are still being detected in the ground water, and with generally increasing concentrations and number of VOC constituents.

If you have any questions, please give me a call.

Sincerely,

Pat Potts

Pat Potts
Environmental Specialist

cc: Margaret Hofacker, GeoResearch, Inc., 115 N. Broadway, Billings, MT 59101

Dr. George Sheckleton, Yellowstone County Health Officer, City-County Health Department, P.O. Box 35033, Billings, MT 59107

Chuck Rogers, Mayor, City of Laurel, P.O. Box 10, Laurel, MT 59044

Kevin Chappell, Surface Management Bureau, Montana Department of State Lands, 1625 Eleventh Ave., Helena, MT 59620

path: sw\laurel.asm
file: yellowstone co.\laurel II (closed)\grd wtr

Re: Yellowstone Co.
Laurel (closed)
grd wtr (corresp)

FIRE/AMB/POLICE
215 W. 1ST ST.
PHONE: 628-8737
FAX: 628-4641

CITY HALL
115 W. 1ST ST.
PHONE: 628-8791
FAX: 628-2241

City of Laurel

P.O. BOX 10
LAUREL, MONTANA 59044

RECEIVED
NOV 12 1996
Montana Department of Environmental Quality
Waste Management Division
DEPARTMENT

November 9, 1996

Jon A. Dilliard
Waste Management Division
Solid Waste Program
P.O. Box 200901
Helena, Mt. 59620-0901

RE: CITY OF LAUREL LANDFILL (CLOSED), WITH GROUNDWATER MONITORING WAIVED.

Dear Mr. Dilliard:

As referenced in your letter of July 5, 1995, the City of Laurel was granted a waiver of Groundwater Monitoring effective that date.

Enclosed you will find a proposal from Maxim Technologies, Inc. to abandon the six monitoring wells for the City of Laurel. The work is scheduled for November 13, 1996.

This letter is to make you aware of the intended work and to assure you have an updated file on the Laurel (CLOSED) Class II Landfill, License No. 203.

I faxed a copy of this letter to your office on November 9, 1996. (fax # 1-406-444-1499)

sincerely,

James A. Flisrand

James A. Flisrand
Director Public Works

CITY OF LAUREL MONTANA

November 9, 1999

Jon A. Dilling
Water Management Division
State Water Program
P.O. Box 20981
Helena, Mt. 59620-0901

RE: CITY OF LAUREL LANDFILL (CLOSED) WITHDRAWAL FOR MONITORING WELLS

Dear Mr. Dilling:

As referenced in your letter of July 5, 1995, the City of Laurel was granted a waiver of Groundwater Monitoring effective that date.

Enclosed you will find a proposal from Alcorn Technologies, Inc. to abandon the six monitoring wells for the City of Laurel. The work is scheduled for November 15, 1999.

This letter is to make you aware of the intended work and to assure you have an updated file on the Laurel (CLOSED) Class II Landfill, License No. 202.

I faxed a copy of this letter to your office on November 9, 1999. (fax # 1-406-444-4409)

Sincerely,

James A. Ellerd
Director Public Works

MAXIM
TECHNOLOGIES INC

Consulting Engineers & Environmental Scientists
600 South 25th Street
P O Box 30615
Billings, MT 59107

Telephone: (406) 248-9161
Fax: (406) 248-9282

August 20, 1996

Mr. James A. Flisrand
City of Laurel
Public Works Department
115 West First
Laurel, MT 59044

ENV PRO 96-74

SUBJECT: **Proposal for Monitor Well Abandonment**
City of Laurel Landfill
Laurel, Montana

Dear Mr. Flisrand:

Maxim Technologies Inc., is pleased to present this proposal for monitor well abandonment at the City of Laurel Landfill. This proposal is presented in response to your request in our telephone conversation dated August 8, 1996.

SCOPE OF WORK

The proposed services include abandonment of six monitoring wells in accordance with the Administrative Rules of Montana Title 36, Chapter 21, Part 810.

Our proposed work plan consists of the following:

- Maxim personnel with current Montana Monitor Well Contractors Licenses will fill all six monitor well casings with bentonite chips in a manner that will prevent bridging. The City of Laurel will supply a backhoe and operator to excavate to a minimum depth of three feet below ground surface around each monitoring well. Maxim personnel will then cut the casing at a minimum of three feet below ground surface. The city of Laurel will backfill the excavation with in accordance with the existing Laurel landfill closure requirements.

- Following completion of the well abandonment, Maxim will prepare a letter signed by a licensed monitor well installer which will document the well closures. Three copies of this documentation will be provided to the City of Laurel.

File: Yellowstone Co. Laurel (II) closed grd wtr (con)

Roger,

RE: No-migration petition - City of Laurel - dtd 5/9/95

We are in receipt of the city of Laurel's application for a no migration petition for their old landfill. Bob would like to review whatever decision you make on this issue prior to an official notice going back to the city of Laurel. Please yell when you have completed your review and are ready with a decision. Thanks.

Curt
5/17/95

Jon + staff,

Please set, and provide to me, a target date for a draft decision + response on this.

RCT

RECEIVED
MAY 19 1995
RCT
Montana Department of Health
and Environmental Sciences
Waste Management Division

FIRE/AMB/POLICE
217 W. 1ST. ST.
PHONE: 628-8737

CITY HALL
115 W. 1ST ST.
PHONE: 628-8791

City of Laurel

P.O. BOX 10
LAUREL, MONTANA 59044

MAY 9, 1995

B. Robinson
W.J. Opitz
Cust

PUBLIC WORKS
DEPARTMENT

RECEIVED
MAY 11 1995
MDHES
DIRECTOR'S OFFICE

Mr. Robert Robinson
Director
Health and Environmental Sciences
Cogswell Building
Helena, Mt. 59620

Dear Mr. Robinson:

Enclosed please find the City of Laurel's no-migration petition for the former Laurel sanitary landfill.

In reference to our previous meeting with you and the Department of Health and Environmental Science staff in early February, the letter of February 23, 1995 from Jon Dilliard and our telephone conversation on March 20, 1995; I believe this submittal will cover all concerns discussed.

If you or your staff have any questions or concerns please contact me at your convenience.

Sincerely,

James A. Flisrand
James A. Flisrand
Director of Public Works

JAF/cl
cc: Mayor
chrono. file

File: Yellowstone Co, Laurel II, Lic No 203 grd wtr (memo to the files)

MEMO TO THE CITY OF LAUREL CLASS II LANDFILL (CLOSED) LICENSE NO.203

HYDROGEOLOGIC RESPONSE TO THE MAY 1995, CITY OF LAUREL'S CLASS II LANDFILL REQUEST FOR NO MIGRATION APPROVAL

HISTORICAL BACKGROUND

When the request for a no migration petition approval was initially expressed by GeoResearch for the City of Laurel Class II Landfill in the September 4, 1993 Work Plan for the Hydrogeologic Investigation, the Department had no hydrogeologic and soils test data available from the site at that time. There was no site-specific investigatory information from which to determine hydraulic conductivity (K) and velocity of the ground water (i.e., migration rates), or an accurate depth to water at the site. The Department responded to this generic no migration request in a letter dated October 6, 1992, which stated that the hydrogeology and soils at the site must be adequately characterized before the Department would be able to consider a no migration petition for this site [see pages 2 through 4 of the October 6, 1992 correspondence, and refer to ARM 16.14.714(2)(a)].

1992 REVIEW OF HYDROGEOLOGIC AND SOILS STUDY SUBMITTAL

As hydrogeologic information did become available at this site through the required field investigations for the Hyrogeologic and Soils Study [see ARM 16.14.703(1)], the Department reviewed this data. The Department made comments on the data presented in the 1992 Hydrogeologic and Soils Study in a letter dated March 29, 1993. Some of the issues raised then by the Department that are related to the evaluation of a no migration petition at this site were:

* Inadequacies to specific rule requirements were cited, such as ARM 16.14.703(1)(a)(v)(C). This is a requirement to address and describe the vertical and horizontal components of the local flow system.

* Item #4, in the Department's letter-review, questioned the rational used in interpreting both confined and unconfined ground water conditions in this same, or similar shallow saturated zones at this site. It was the intent of the Department to gather additional information concernign ~~concernign~~ the rational used in the placement of the screen in each well to be able to more clearly evaluate the hydraulics in the shallow ground water bearing zones, by questioning the screening

placement for each well. This particular issue was a weak point in the hydrogeologic interpretation of the site according to Huntingdon's May 1995 no migration petition, as well.

* Number 6, in the March 29, 1993 correspondence also reiterated the Department's concerns with storativity values used and the appropriate application of equations used in transmissivity calculations to arrive at K, and ultimately, calculate migration rates (vertical and horizontal).

When verbally questioned over the phone by GeoReseach in the past concerning a request for a no migration petition at the City of Laurel's Class II Landfill, the Department had only the 1992 hydraulic data acquired at the site to work with. In most cases the Department used average values whenever referred to in the text, as most of the data was considered, even by GeoResearch, to be inconclusive and questionable. Therefore, the Department used the following values in calculating ground water migration rates at the City of Laurel Class II Landfill site:

Vertical K from 1992 Guelph permeameter results where K ranged from 0.021 ft/da. to 0.051 ft/da., arriving at a vertical downward migration rate of from 0.0023 ft/da. (0.84 ft/yr.), to 0.51 ft/da. (186 ft/yr.).

This would mean with a 10-foot deep trench excavation, where the depth to ground water is 17 feet below ground surface (BGS) (i.e., MW-2), it would as long as 5.9 years, to as little as 13.73 days to travel 7 feet vertically downward to reach the water table.

As for horizontal K, the Department only had the 1992 slug test data with calculated values ranging from 0.16 ft/da. to 8.3 ft/da.; averaged in the text at K = 2.8 ft/da. The original hydraulic gradient (I) used was 0.012 ft/ft, with an estimated effective porosity of 10%. Therefore, the rate of ground water flow was calculated to be approximately:

$$\frac{2.8\ ft/da\ (.012\ ft/ft)}{10\%} = \frac{0.0336}{.10} = 0.336\ ft/da \times 365 = 122\ ft/yr.$$

This calculation would indicate that it would take less than 6 months for leachate in the ground water to travel approximately 50 feet to impact the natural quality of the ground water in MW-2, of which we have seen analytical evidence of impacted shallow ground water from previous monitoring data at this well.

Neither the vertical, nor the horizontal rates of migration calculated from the data as presented in 1992 were indications that leachate would not be able to migrate into the shallow ground water-bearing zone(s), and reach the relevant point of compliance

(RPOC) presently required to be monitored at this site.

1994 GEORESEARCH DATA (REVISED)

In the February 9, 1994 Hydrogeologic and Soils Study, the only obvious deviations from the above data were:

1. The R-1 single ring infiltrometer test was resumed in September/October 1993. The first test in 1992 was considered to be inconclusive, but K was estimated to be 0.00023 ft/da. from that original test data. This is the vertical K that Huntingdon has used for their calculations for the vertical migration rates at the site.

   However, in 1993 the test was resumed, the new data was calculated, and the revised K value was determined to be 0.00048 ft/da. This value for vertical K was used by GeoReserach in the conclusion of the 1994 report, as the vertical K that is representative of the site.

2. A slug-out test was conducted in 1993 on the new well (deeper ground water-bearing zone) MW-2D. Test results were calculated to arrive at a K value of 0.0179 ft/da. and was substituted in the 1994 report conclusions to be representative of horizontal K, even though this well was recognized as being completed in a deeper ground water-bearing zone than the other monitoring wells. Hydraulic gradient (I) also was revised according to December 1993 water level information to be 0.18 ft/ft. This is steeper than the original 0.012 ft/ft provided in the original hydrogeologic and soils investigation report.

All of the 1994 report data was still in agreement with the confined-unconfined hydrogeologic interpretation of this site. In the finalization of the 1994 report, no written recommendation was made to the Department to evaluate use this information as evidence for a demonstration for a request for a no migration petition approval [see ARM 16.14.714(2)].

1995 HUNTINGDON DATA & INTERPRETATION - NO MIGRATION PETITION

According to the no migration petition submitted to the Director of the Department on May 11, 1995 by the City of Laurel for the Class II Landfill (license number 203), Huntingdon, the City's contractor for this task felt that it was necessary to conduct their own slug tests on several of the existing monitoring wells (i.e., MW-1, MW-2D, and MW-3). These new slug tests were run because Huntingdon reportedly felt that the horizontal K values previously reported may not have been representative of the horizontal rate of ground water flow in the shallow water bearing system. Apparently, Huntingdon was satisfied with the R-1 vertical K rates from the original 1992 infiltrometer test, and chose to use the 0.00023

ft/da as vertical K.

Therefore, the K values used to calculate the rates of migration in the unsaturated and the saturated zone according to Huntingdon are now:

Vertical K = 0.00023 ft/da (0.08 ft/yr), and

Horizontal K = 0.0009 ft/da (0.33 ft/yr), to 0.08 ft/da (25.6 ft/yr)

In reality, vertical downward migration of leachate need only travel approximately 7 feet to reach the upper ground water-bearing zone presently being monitored in MW-2.

According to Huntingdon's calculations, vertical rates of migration which range from 0.00064 ft/da to 0.0064 ft/da, using I = 28%, and 10% and 1% respectively, for effective porosity, leachate could migrate in as little as 3 years into the shallow ground water-bearing zones, or it could take up to 35 years for leachate to enter the shallow ground water-bearing zones.

It is important to consider that 30 years is only the post closure period and the active life of the landfill (i.e., 10 years), plus closure, must be added to the 30 year post closure period to provide the most accurate timeframe for the actual interpretation of the rate of migration in the unsaturated, as well as the saturated zone.

MW-2 is located at the east property boundary/RPOC and is relatively contiguous with the edge of the waste, it need not take more than about 50 feet horizontally in the direction of ground water flow for leachate contamination already present in the ground water (due to vertical migration) to impact the quality of the ground water in MW-2. Travel times for a 50-foot migration distance in the ground water could be as rapid as 8 years, to as long as 1,667 years using Huntingdon's recent slug test data. Evidence of the applicability of the more rapid migration rates can be seen in the impacts that have already been observed in MW-2 which consist of traces of VOCs, elevated nitrates, and the relatively higher specific conductance in this well, as compared to the rest of the monitoring wells hydraulically down gradient from the landfill.

The demonstration presented by Huntingdon which emphasizes that no one drinks or uses the shallow ground water in this region, does not negate the apparent impacted quality of the water found in at least 1 of the down gradient monitoring wells. Because the City of Laurel cannot foresee any possible usage of the naturally poor quality of the shallow ground water at this site.

The aspect of natural water quality with regard to a no migration petition deals with ground water usage and potential usage. Although, this is not a criteria directly required for the

evaluation of a no migration petition, it has been used as another issue to negate ground water monitoring at this facility. The Department agrees that water qualitites are generally poor at the site for a variety of reasons. Present day water usage is essentially from the Yellowstone River. Therefore, if required to adress Corrective Measures for elevated constituents such as VOCs and nitrates, the City's response surely would be along these water quality/water usage issues and Corrective Measures may be deferred according to a no action alternative (ARM 16.14.708(1)(e), specifically keying on ARM 16.14.708(1)(e)(ii)(A) and (B). However, continued Assessment Monitoring would still be a requirement, and apparently an issue with the City of Laurel.

NOTE: Recharge rates have also varied drastically from the 1993 GeoReseach report that stated the recharge rate for MW-2D was 0.00010 gpm, or 0.16 gpd; as compared to the recharge rate proposed by Huntingdon in the May 1995 no migration petition that was given as 0.002 to 0.006 gpm, or 8.64 gpd..

NOTE: An error was found in the date of closure (i.e., the last day, or even year that waste was recieved) for this facility according to information provided in the introduction of Huntingdon's 1995 no migration petition (see below).

Time frames applicable to closure -

Pg. 1 of 1995, No Migration Petition

"A second licensed area (License No. 203, Figure 2) was permitted in 1982 and was used until September, 1990. After September 1990, the City of Laurel began hauling wastes to the Billings Sanitary Landfill and closed the landfill."

These two statements cannot be accurate because:

1) The Department inspected the transfer station and the landfill on February 4, 1992,

2) A letter dated August 17, 1992, from Mr. James Wilbur with the Department, discussed the timing of the actual closure, and that at that time Mr. Worthingdon with the City of Laurel, had mentioned that the landfill was full, to having a limited capacity,

3) It wasn't until November 11, 1992 that the Department approved the closure plan, and

4) In an inspection report dated August 23, 1993 Mr. Craig Stagner with the Solid Waste Program, stated that the City would stop taking waste at the landfill prior to January 1, 1993.

memo by: Pat Potts 6/5/95

2/1/95

~~Contract Management Training~~ ~~Part III~~

2/9/95 Pat Dubay, Chuck Rogers, Jim Fleissner (Laurel) Cert C, Bob R, Roger, John Arriga Laurel landfill.

Review of Laurel position paper. Still want a no-migration. Contend that the water is not an aquifer. They maintain that the uppermost is 2000 feet deep.
Claim the recharge rate takes weeks? Rates indicate that wells generate about 3 gal in 8 hours.
Organics in wells are from gas.
Dept needs to establish what an aquifer is.
WQD (John Arriga) does not consider the water at the landfill is an aquifer.
Suggestion to continue table I monitoring only.

No monitoring required. Get letter to Laurel no later than 2 weeks.

Lateral movement. Nearby receptors.

FIRE/AMB/POLICE
217 W. 1ST. ST.
PHONE: 628-8737

CITY HALL
115 W. 1ST ST.
PHONE: 628-8791

City of Laurel

P.O. BOX 10
LAUREL, MONTANA 59044

February 9, 1995

PUBLIC WORKS
DEPARTMENT

Robert Robinson
Director
Health and Environmental Sciences
Cogswell Building
Helena, Mt. 59620

Dear Mr. Robinson:

To briefly describe the City of Laurel's situation I need to emphasize, we believe in a safe environment, safe procedures and following the intent of environmental regulations.

The City of Laurel's Director of Public Works position has had four Directors in the last six years, and has been without a Director a number of months during that same period. I indicate this history to explain the lack of direction and guidance during the process of closing the landfill.

When I was employed by the City of Laurel this last fall it quickly became apparent the solid waste issues needed attention. I wrote two letters to Ms. Potts dated September 27, 1994 and November 10, 1994 indicating we hired another consultant for a second opinion, and that we may need to consider another direction.

Mr. Dilliard responded for Ms. Potts on December 7, 1994. I appreciate his comments regarding our concerns and his decision not to require an assessment of corrective measures or any corrective action, as previously requested by Ms. Potts.

The City of Laurel feels, as stated in my November 10, 1994 letter that we qualify for a No-migration approval. Mr. Dilliard's response to our request however, didn't elaborate on why he disagreed with our conclusion. In our opinion, Huntingdon Consulting Engineers submitted conclusive proof that the City

of Laurel's landfill is located on the Colorado Shale Formation and, in accordance with research data, the nearest aquifer is 2000 feet below the surface.

Apparently, your department would not accept Huntingdon's professional opinion, and therefore, I obtained two additional opinions from professional hydrogeologists experienced on this subject and familiar with this area. Their opinions were identical to Huntingdon's and are enclosed for your review.

I chose to go one step further and requested an opinion from the State funded research team at the Montana Bureau of Mines and Geology. The hydrogeologist, Mr. Duaime, developed research data that was published in 1991 relating to the Colorado Shale Formation. Mr. Duaime also agrees with Huntingdon, that the Colorado Shale does not produce sufficient quantities of water to be considered an aquifer. His letter is enclosed for your review. In accordance with ARM 16.14.714(1), "Ground water monitoring at the facility may be waived by the Department if the facility owner or operator can demonstrate there is no potential for hazardous constituents to contaminate the uppermost aquifer."

To our knowledge there has been at least four communities within the State of Montana that have received No-migration approval. All but one have geology similar to the Laurel landfill. The one community different from the other three has a landfill on fractured rock with a large aquifer 400 feet below the surface. I personally would feel more comfortable with 2000 feet of clay, bentonite and shale then 400 feet of fractured rock.

The City of Laurel doesn't want to take chances with contaminating the environment. The concern in this case of possible contamination of any aquifer, is just not feasible, in the Laurel landfill area. All wells within a mile or more are not potable, not even for livestock. Nitrates are common to this area, research has documented 10 to 15 times greater concentration of nitrate then the level detected in the one well of the Laurel landfill. the landfill is no longer in operation and has been officially closed, I feel that is additional reason to be granted a No-migration status.

In conjunction with the No-migration approval, the City of Laurel understands and expects to maintain a proper landfill cap. If the department has any concerns with the existing cap or anticipated erosion, the City of Laurel would appreciate your guidance.

To summarize, I respectfully request your approval of our position, or indicate what type of data your department will require to obtain your approval. Our position is environmentally sound, we are supported by professional hydrogeologists, your department has justification to approve a No-migration, and your approval would be consistent with previous decisions made by your department. The hydrogeologists that have visited our site quickly understand our position, its too bad your technical people have chosen not to visit our site.

Sincerely,

James A. Flisrand

James A. Flisrand
Director of Public Works

cc: Ken Miller, State Senator
Brad Molnar, State Representative
Alec Hansen, League of Cities and Towns
Chuck Rodgers, Mayor
file
chronological file

AQUONEERING
1535 SAGE CIRCLE
LAUREL, MONTANA 59044
(406) 628-2202

December 21, 1994

Mr. Jim Flisrand
Director of Public Works
City of Laurel
P.O. Box 10
Laurel, MT 59044

Dear Jim:

This letter is in response to your request for our professional opinion as to the suitability of the upper layer of soil near the sanitary landfill as an aquifer. Most definitions of an aquifer include the words "significant yield", "economically viable production" and "water in quality and quantity useful to mankind". We have investigated the potential for domestic and stockwater many times in this area, each time concluding that development of a well is not feasible due to very low yields and poor quality water. We own a home in the NW 1/4 of section 4, just over 1 mile from this site and we are on the very fringe of what we consider to be an aquifer. Neighbors have tried to develop water from the surface layer overlying the Colorado Shale several times, using techniques such as casing storage, timed pumping to a cistern and RO treatment. All are now hauling water to cisterns from the City of Laurel water system, realizing their efforts were not feasible. We do not consider the soils beneath the landfill through the Colorado Shale to be an aquifer under any definition. The nearest alluvial aquifer is over 1 mile away. In any case, the small quantities of water delivered to the valley aquifer out of the upper layer would rapidly be diluted to almost undetectable values by water flowing in more permeable sands and gravels.

Movement of groundwater is very slow given the silty clay texture of the upper layer of soils. We have found typical values for HC of 0.01 to 0.03 feet/day from pump-in tests we have conducted in this area. The hydraulic gradient must be steep to transmit even small quantities of water originating from recharge, often 0.05 ft/ft or more. The Darcy velocity ranges from 0.0005 to 0.002 feet/day indicating movement of a water particle each year of less than 0.5 foot. The Colorado Shale exhibits even lower HC values. Obviously, the risk of contamination of the valley aquifer is very low.

As with non-degradation issues we continue to make the following recommendations:

REPLACE PRESCRIPTION WITH UNDERSTANDING: We must actively seek an understanding of how systems perform and what levels of risk to public health and the environment the public is willing to accept. Empirical relationships and arbitrary standards are no longer adequate.

REPLACE PRESCRIPTION WITH PERFORMANCE: We must define acceptable performance and see that the systems are designed or modified to meet these standards. The site should determine the system design and performance; not codes, rules and regulations.

REPLACE CONSERVATISM WITH MANAGEMENT: We must recognize that management is essential to performance and protection. No system is failure proof and there are no guarantees of performance in earth sciences related designs. We must react to shortcomings in performance rather than hoping they never occur. A conservative approach simply results in unnecessary expenditure of valuable resources needed for all to compete in a world economic climate.

Hope this sheds some light in a small way. MERRY CHRISTMAS AND A REGULATION FREE NEW YEAR.

Sincerely,

Roger Perkins, PE

GEORESEARCH, INC.

December 22, 1994

Mr. James Flizrand
Director of Public Works
P.O. Box 10
City of Laurel
Laurel, Montana 59044

Re: Summary and Considered Opinion -- The Uppermost Groundwater at the Laurel Landfill as an "Aquifer"

Dear Mr. Flizrand:

In accordance with the requested deliverables and our contracted scope of work pursuant to our existing Task 8a, GeoResearch, Inc. has conducted a review of the occurrence of groundwater at the Laurel Landfill. This review included comparison of its natural occurrence and that concerning regulatory definitions and applicability of certain requirements imposed at the landfill by the Montana Solid Waste Program (MSWP) via the Montana Solid Waste Management (MSWP) Laws and Regulations (ARM 75-10-207 and 16.14 Sub-Chapter 7). These conclusions are presented to the City of Laurel as our qualified and professional opinion of the occurrence and character of groundwater at this site and our understanding of the appropriate regulations referenced below. The basis of this review is the findings and results of the following studies and correspondence which GeoResearch has completed at the Laurel Landfill for more than two years:

- 1994a, Post Closure Plan, City of Laurel Landfill, dated February 3,
- 1994b, Hydrogeological and Soils Study, City of Laurel Landfill (License #203), dated February 9,
- 1994c, Annual Report: Groundwater Monitoring Activities (May '93 - May '94), Laurel Landfill (License #203), dated August 1,
- 1994d, Final Statistical Evaluation of Historical Groundwater Analysis Data, Laurel Landfill (License #203), dated December 6, and
- 1993, Letter to Ms. P. Potts, Montana Solid Waste Program (enc: Revised Calculations to Determine Extent of Contaminant Plume, Laurel Landfill), dated August 24.

Figures 1 - 4 (GeoResearch, 1994a) and Figures 3-1 and 3-2 (GeoResearch, 1994b) are enclosed as reference maps for this review of the groundwater conditions at the landfill.

115 North Broadway
Billings, MT 59101
TEL. (406) 248-6771
FAX (406) 248-6770

James Flizrand
December 22, 1994
Re: Landfill Aquifer

I. Laurel Landfill On-site Operations and Closure:

According to documents obtained from MSWP, a dump site in the vicinity of the Laurel Landfill was opened in 1965. This dump may correspond to two fill areas which were previously identified in the Post Closure Plan. One site is located north and adjacent to former License #24. Landfill license #24 was operated from 1978 to 1983 and MCA 75.10.204(5) does not apply. License #203 began operations in 1982 and stopped receiving waste in September 1990. A written closure plan was approved by MSWP on December 17, 1992, and closure inspections were conducted on March 5 and June 21, 1993. The MSWP letter verifying landfill closure is dated August 23, 1993. By virtue of regulations effective October 1993, ARM 16.14.501(5), the Laurel Landfill License #203 is subject only to final cover requirements (ARM 16.14.531(1)(a)(iii)) and post closure groundwater monitoring (ARM 16.14.711-712).

Previous activities and operations conducted on or in the upgradient vicinity of License #203 have included penned livestock (pig) feeding, on-site solid waste dumping, disposal and burial, spreading of dried sewage sludge as a soil cover amendment, solid waste haulage and transfer, and heavy equipment parking. The livestock operations were located on-site prior to landfilling activities. Due in part to the collective design and flow direction of perimeter drainage features north of the pre-existing landfills which extend immediately adjacent to MW-2, the unknown rate of groundwater migration, and the upgradient location of the former pig farm just north of background well MW-4, the potential of the farmstead, and/or similar operations on neighboring lands, as a (the) significant source of nitrate contamination in groundwater underlying the facility would seem possible. In view of the onsite location of MW-4, its proximity to the farmstead, its status as the only background well, and unknowns concerning offsite upgradient hydrogeology and water quality, the unaffected or natural water quality in the uppermost groundwater saturated zone is not able to be assuredly determined.

II. Groundwater Monitoring Requirements:

The detection of nitrates in groundwater <u>on</u> the facility at levels above the EPA and State maximum contaminant levels (preventative action limit) and the MSWP letter dated February 1, 1994 required the Laurel Landfill to implement Assessment Monitoring (i.e., ARM 16.14.708(1)).

III. Laurel Landfill Hydrogeology:

The hydrogeologic occurrence and character of groundwater at the Laurel landfill is discussed in detail in the <u>Hydrogeological and Soils Study</u>, (GeoResearch, 1994b). Depth to the uppermost groundwater-bearing zone ranges from 17 to 26 feet below the restored land surface. The uppermost groundwater occurs within the Niobrara formation which consists of dense, dark brown to olive-black shale (bedrock) and which contains thin layers of bentonite.

James Flizrand
December 22, 1994
Re: Landfill Aquifer

The Niobrara is a member of the Colorado Group, also a monotonously uniform, consolidated calcareous shale which is 2,000-2,500 feet thick at this location. Sediments overlying the Niobrara are unconsolidated slope wash consisting of silt and silty clay and recent soils. Wells constructed in the uppermost groundwaterzone generally produce less than 1 gpm and the water is highly mineralized; Class IV (ARM 16.20.1002).

Evaluation of results from drilling and well development and monthly water levels from 1992 and 1993 indicates the uppermost shallow groundwater at the Laurel Landfill exists under both slightly confined and unconfined conditions and originates from fractures within the dense shale bedrock. Lateral or vertical structural or hydraulic interconnection of the fractures is not confirmed and considered unlikely between network wells owing to separation distance, small and slow yields, depth to groundwater and its occurrence at different stratigraphic horizons, and expected fracture closure due to overburden weight and possible swelling from wetted smectitic clays. Fracture orientation is not known and the possibility exists for the actual migration or groundwater flow path within the fractures to first originate outside of the facility's property boundary. During drilling of well MW-2D, located 20 ft. downgradient of MW-2, the uppermost shallow groundwater horizon present in MW-2 was not encountered. In MW-2D, total depth 100 ft., the first and only shallow groundwater horizon was at 76 feet and separated from the groundwater horizon in MW-2 by very dense, hard shale and a possible bentonite layer about one foot in thickness. Groundwater in MW-2D required more than two months to attain its static level 12 ft. below that of the other network wells. These hydrogeologic and stratigraphic conditions demonstrate the vertically isolated and apparently non-continuous lateral character of the uppermost groundwater bearing zones in this part of the Niobrara formation which is being monitored at the Laurel Landfill.

Measurements of well recovery after sampling activities and evaluation of slug test results from each of the network wells demonstrate that the formation (strata) exhibiting the uppermost groundwater at the landfill does not yield significant quantities of water. Slug tests conducted in the network wells during the 1993 and 1992 site studies indicate transmissivity (ft^2/sec) and hydraulic conductivity (ft/sec), which are reflective of the intrinsic permeability of the Niobrara formation, both averaged 3.3×10^{-5}, and may be as low as 1.1×10^{-5}. Well recoveries after the April 1994 monitoring event ranged from 0.017 to 0.0056 gpm (8-24 gals/day). These rates are for all practical purposes considered to be insignificant for domestic and irrigation uses of the uppermost shallow groundwater and are at best marginal for stock watering needs.

In April 1994, the groundwater gradient observed in the landfill network wells in the uppermost groundwater bearing zones was at 78 ft/mile (0.015 ft/ft) to the southeast. Updated calculations (GeoResearch, 1993) of the groundwater permeation rates, based on 1993 permeameter readings, indicate the vertical infiltration rate in the soil and bedrock at this facility is 0.1767 ft/yr; or approximately 39 years to travel the 7 feet from the base of the buried waste to the uppermost groundwater in the vicinity of MW-2. The horizontal hydraulic conductivity (migration rate) in the shale bedrock is calculated at 4.89 ft/yr.

The USGS (Heath, 1989) indicates that selected porosity and specific yield of consolidated shale are typically 0-10 percent and 0.5-5 percent, respectively. The hydraulic conductivity of unfractured to fractured shale typically ranges from $10^{-7.5}$ to 10^{-4} feet per day. The range of these properties is comparable to values determined for the Niobrara formation at the Laurel Landfill and demonstrates its intrinsically low permeability which is typical of the Colorado Shale. Consequently, practically no groundwater moves through the Niobrara/Colorado shale formation.

IV. Vicinity Beneficial Use of Groundwater:

The uppermost groundwater being monitored at the Laurel Landfill is Class IV according to the Montana Water Quality Bureau rating (ARM 16.20.1002) and is considered unsuitable and for practical purposes untreatable for higher class beneficial uses.

Only one well is situated in close proximity to the landfill; this stock well is located one-half mile southwest (normal to gradient) where the depth to groundwater was reported at 40 ft. in blue shale. Within a one-mile radius downgradient or oblique of the landfill, no porous or fractured units are described nor are any wells reported constructed in the Niobrara or Colorado Shale that produce groundwater for either domestic, agricultural, or irrigation purposes. The nearest recorded wells downgradient of the landfill are at the Laurel Airport and in the Beartooth and Groshelle Heights subdivisions. These wells are drilled to depths of 40 to 150 feet into water-bearing alluvial sand and gravel deposits that overly the Niobrara and Colorado shales and represent the oldest depositional terrace of the Yellowstone River. The terrace gravels thin northward to zero thickness and are replaced by silty clay before reaching the landfill site and the shale escarpments one-half mile north of the landfill (Gosling & Pashley, C-C', 1973). Well yields of 10-60 gpm may occur where gravels are encountered. The silty layers yield little or no groundwater.

Groundwater in the unconsolidated alluvial deposits and the Niobrara is too highly mineralized to be suitable for widespread human consumption. Use for livestock watering does occur, however in some places livestock refuse to drink it. Dissolved solids and sodium are principal problems affecting specific conductance which make the groundwater from the third (oldest) terrace marginal for use in irrigation (Hutchinson, 1983).

V. Proximity of Useable Aquifers:

Without regards to the quality of groundwater, or its intended beneficial use, those formations which are in closest hydrogeologic proximity to the formation containing the uppermost groundwater at the Laurel Landfill and considered to constitute "aquifers" are the:

- Eagle Sandstone,
- Unconsolidated Quaternary Deposits of the Yellowstone River, and

- Cloverly (sandstone) formation.

The Eagle Sandstone occurs stratigraphically above the Niobrara formation and has been removed from the site by erosion. The occurrence of unconsolidated terrace deposits was discussed above in section IV. The Cloverly formation underlies the 2,500 foot thick Colorado Shale and may yield small quantities (<10 gpm) of highly mineralized groundwater to wells (Gosling & Pashley, 1973).

VI. Use of the Term "Aquifer" Concerning the Uppermost Groundwater, Laurel Landfill:

Regulatory Background:

In accordance with ARM 75-10-207, landfills in operation as of October 1, 1989 (i.e., license #203) "... are required to monitor groundwater as specified by the department"; in essence per ARM 16.14.711-712. The language in ARM 75-10-207 is such that it appears to retroactively impose MSWP regulations which became effective October 1993. MSWP regulation, ARM 16.14.714: No Migration Demonstration allows a waiver of groundwater monitoring at a facility where it can be demonstrated "... there is **no potential** for hazardous constituents to **contaminate** the **uppermost aquifer**."

Current regulatory definitions (see ARM 16.14.702) and the context in which each of the highlighted key words of the definition are applicable to the Laurel Landfill are:

Terminology	Definition
• Contamination	"... degradation of **natural**, background water quality by an undesirable substance not normally present or...",
• Uppermost aquifer	" ... the geologic formation nearest the natural ground surface that is an **aquifer**, as well as **lower aquifers that are hydraulically interconnected** with this aquifer **within the facility's property boundary**",
• Aquifer	"... any geologic formation, **group of formations, or part** of formation, **capable of yielding significant quantities of groundwater to wells** or springs",
• Aquitard	"... geologic formations, group ... or part ..., **exhibiting low permeability and having little or no intrinsic permeability**, that is stratigraphically adjacent to one or more aquifers *and* **through which virtually [practically] no water moves**". .

Confining layers -- Although not included as a MSWP regulatory definition, these layers are "..... geologic units having little or no intrinsic permeability - less than about 10^{-2} darcy [i.e.10^{-5} cm/sec]. This is a somewhat arbitrary limit ..." (Fetter, 1988 and Johnson, 1987). Within the science of hydrogeology, aquitard is sometimes subdivided to include:

- *Aquifuge* - an absolutely impermeable unit that will not transmit any water,
- *Aquitard* - a layer of low permeability that can store groundwater and also store and transmit it slowly from one aquifer to another (Fetter, 1988), and which yield some water, but usually not enough to meet even modest demands (Johnson, 1987), and
- *Aquiclude* - a unit of low permeability ... located so it forms an upper or lower boundary to a groundwater flow system (Fetter, 1988) and through which virtually no water moves (Johnson, 1987).

VII. Conclusions:

Considered in total, the hydrogeologic character, properties, and results of traditional aquifer tests demonstrate the part of the Niobrara formation being monitored at the Laurel Landfill is incapable "... of yielding significant quantities of groundwater to wells or springs". The quality of the groundwater is generally useable for agricultural, livestock, irrigation or domestic beneficial uses.

Although the MSWP use of "significant" is not defined, and is apparently arbitrary, a lower limit to be considered is that required by Montana DHES for a domestic, single-family water system (ARM 16.16.303(5)); a sustained well yield of at least 5 gpm over a four hour period. During the initial four hours of pump testing conducted in MW-1 (1993), the maximum sustainable yield was typically less than 0.5 gpm. Later in the testing, this level was not able to be maintained without completely depleting the well.

Therefore GeoResearch does not consider, and would recommend to the MSWP, the uppermost groundwater at the Laurel landfill to meet the MSWP regulatory definition of an "aquifer", either widespread or localized. As such, the occurrence of groundwater would seem to more appropriately be termed "water-bearing zones" within a part of the Niobrara formation/Colorado shale. As discussed above, the hydrogeologic properties of the formation effectively act and have the demonstrated properties typical of and those stated in the regulations (ARM 16.14.702(5)) to be defined an "aquitard." and hydrogeologically an aquiclude confining layer. Because the formation fails to meet the defining criteria of "significant yield" for an "Aquifer", it likewise fails by definition as an "Uppermost Aquifer" (ARM 16.14.702(50)). As such, the landfill and the groundwater encountered on the facility would seem to qualify for demonstration and receive a no migration designation. Information presented in the reports listed

in Section I, above, provide site-specific field measurements and interpretations required by ARM 16.14.714 (1-3).

In accepting this conclusion and its regulatory implications pursuant to MSWP Solid waste regulations, the requirement for groundwater monitoring at the facility may be waived by MSWP.

The existing point of compliance well, MW-2, is inadequate to ascertain if offsite groundwater pollution has occurred. Lateral interconnection, onsite flowpath, and offsite migration of the uppermost groundwater being monitored in each of the landfill network wells is not confirmed. Although not specifically stated in the current solid waste regulations, Ms. Pat Potts of the MSWP has stated to GeoResearch that if pollution of the uppermost groundwater were shown to be limited to the landfill property, then corrective action would not be required in lieu of continued groundwater monitoring.

GeoResearch believes this summary of the groundwater conditions at the Laurel Landfill to be correct, within the interpretated limits of the available field data, and accurately represent them concerning current MSWP solid waste regulations. Should you have any questions concerning the information presented herein, please do not hesitate to contact me in our Billings office.

Sincerely,

James D. Shaffer
Sr. Hydrogeologist

enc. Figures 1, 2, 3, 4, 3-1, and 3-2.

MONTANA TECH
of The University of Montana

Montana Bureau of Mines and Geology
1300 West Park Street
Butte, Montana 59701-8997
(406) 496-4180

January 19, 1995

Mr. Jim Flisrand
Public Works Department
P.O. Box 10
Laurel, MT 59044

Dear Jim:

I have reviewed the information contained in your 12/23/94 letter, concerning the Colorado Shale as an aquifer. I have discussed your situation with Marvin Miller of our staff also.

Based upon our experience, we feel that the Colorado Shale would not be considered an aquifer because: 1) it does not produce sufficient quantities of water, and 2) the quality of the water within it is very poor.

In discussing this site with Marvin, questions arose concerning revegetation of the site, associated with its closure. While the Colorado Shale does not produce large quantities of water, it does contain water and the soil material contains large quantities of salts, which can be leached out, resulting in additional degradation of water quality.

It is probable that when the native cover material was removed for construction and operation of the landfill, that changes occurred in the local groundwater system, which might impact the alluvial aquifer system located south of the landfill. The change in the groundwater flow system might be similar to that associated with saline-seep development in dryland farming areas, underlain by Colorado Shale. The groundwater quality data, contained in your correspondence, seems to support this. Therefore, I would suggest the use of deep rooting legumes that can use

excess moisture, eventually resulting in a lowering of groundwater levels in and downgradient of your site. The use of this excess moisture through plant growth, will limit additional leaching of soluble salts and lessen further degradation of the existing water quality. Ms. Jane Holzer, of the Montana Salinity Control Association, Conrad, MT, can provide you with suggestions for plants to use in revegetation. Her phone number is (406) 248-3071.

I hope you find the above suggestions appropriate. While the Colorado Shale would not be considered an aquifer in your area, changes can occur in the shallow groundwater flow systems associated with it, which can impact other aquifers downgradient. That is the reason for my concern about this site's revegetation. I do believe this is a relevant issue in response to your question as to how the Colorado Shale may relate to aquifers in the area.

I hope the above discussion addresses your questions. If you have questions concerning my comments, do not hesitate to contact me.

Sincerely,

Ted Duaime

Ted Duaime
Hydrogeologist

c: Marvin Miller, MBMG
TD/bb

Huntingdon

Chen-Northern, Inc.

1610 B Street
Box 4699
Helena, Montana 59604
(406) 443-5210
Fax: (406) 449-3729

December 14, 1994

Mr. Jim Flisrand
Public Works Director
City of Laurel
115 West First
Laurel, Montana 59044

Dear Mr. Flisrand:

In their letter of December 7, 1994 (Montana Department of Health and Environmental Sciences, Waste Management Division to James A. Flisrand, City of Laurel), MDHES claims the water-bearing unit immediately beneath the Laurel Landfill is an "aquifer" as defined in ARM 16.14.702(4), and, therefore, is subject to regulation. Under ARM 16.14.702(4), the unit must be "capable of yielding significant quantities of ground water to wells or springs". MDHES concedes that the yield to wells at the landfill is low, but apparently believes the existence of a "spring" in the area is proof of significant yield; hence the water-bearing unit must be an aquifer.

The "spring", located approximately one-half mile north of the landfill, in reality, is an area of groundwater seepage that occurs near the upper end of an ephemeral drainage that trends north to south. Because overland "flow" is not noticeable in this area and the base of the ephemeral drainage is dry a short distance downgradient from the seepage area, it stands to reason that the rate of groundwater discharge to the seep is "insignificant". For this reason, and because recovery rates in all monitoring wells at the landfill are extremely low (0.02 to 0.006 gallons per minute), we stand by our contention that shale bedrock at the Laurel Sanitary Landfill is not an "aquifer", by definition.

Sincerely,

Patrick Dunlavy
Senior Hydrogeologist

Myles F. Grotbo, P.G.
Regional Vice President

FILE: Yellowstone Co
Laurel (II) closed
grd wtr

December 1, 1994

MEMORANDUM

TO: Pat Pots, DHES
Solid and Hazardous Waste Bureau

FROM: K. Jason Campbell, Supervisor, Land Management Section
Surface Management Bureau, Helena

kjc

SUBJECT: R.O.W Deeds on State Lands
City of Laurel Landfill
License #203

Further to our telephone conversation of the other day, enclosed are copies of current deeds we are holding for the City of Laurel Landfill Sites on the above noted state lands. I have also enclosed a copy of our control card which shows all lands for which deeds have been issued since DSL began keeping records. Please note that several other deeds have been granted for other landfills that were operated by the County.

I think we lucked out on the current landfill deeds for the City of Laurel, as both have some language that addresses environmental protection or adhering to the existing regulations of the Department of Health.

If you think we can be of some assistance in this matter please call me, and we can discuss the problem and alternative solutions at length. This may even warrant a meeting to see if some action of our Land Board may be solicited to develop a cooperative effort at getting these ground water problems addressed before they become irreversible ground water problems.

RECEIVED
DEC 02 1994
Montana Department of Health
and Environmental Sciences
Waste Management Division

RECEIVED
DEC 02 1994
Marine Department of Public
and Environmental Services
State Emergency Division

Farm Loan Amortization Mortgage Book or Farm Loan Certificate Book for statement of amounts owing, taxes paid, etc.)

APPRAISALS

when loan made	$10,580.00	Value of improvements at time of loan	$120.00
al of land		Present value of improvements	
st appraisement		Date of last valuation	
ent made by		Valuation made by	
		Remarks:	

ADVERTISED FOR SALE

DATE	PRICE PER ACRE

RIGHTS OF WAY AND EASEMENTS

	NAME	FOR	PART SEC.	ACRES	BOARD RECORD	PRICE	NO. R/W PATENT	
39	Yellowstone County	Road	W½SW¼ SE¼NW¼	9 35	7-12-39	$71.06	D-2693	Rec 45367 4-1-44
2	the City of Laurel	Garbage Land Fill	NE¼SE¼SE¼	7.00	4-11-62	$140.00	D-4564 X	Rec# 10981 5-7-62
6	Yellowstone County	Dump Site	NW¼NW¼	20.66	2-9-66	$516.50	D-5408	Rec# 42748 4-7-66
6	City of Laurel	municipal sanitation Easmt.	S½SE¼	4.54	3-9-66	$25.00	D-5711 X	Rec# 76140 3-5-68
7	State Highway Comm.	Highway	W½	1.85	9-13-67	$55.50	D-5627	Rec# 66581 10-25-67
7	City of Laurel -	Municipal Airport	SE¼	52 71	12-13-67	1,317.25	D-5648	Rec# 67806 11-20-67
73	City of Laurel -	Landfill Dump	{NW¼NW¼ SW¼NW¼}	10.00		$250.00	D-6282 X	Rec. # 57,995 10-23-73
	~~City of Laurel - Landfill Dump~~		SW¼NW¼	10.01	10-15-73 10-21-81	2500.00	D-7721 X	Rec: 10997 Date: 12/28/81
	~~Yellowstone County~~	existing road	S½SE¼	3.022	8-89	1,200	D-	#
8	Laurel Municipal Airport - for airspace protection		NE¼ SE¼ S2SE¼	23.765ac.		$8,317.25	Terminated D-9084	R#327, 7-23-90
94	Laurel Airport Authority	Airport Development	S½	23.762 AC.			D-9561	Rec.# 520 8-15-94

RIGHT OF WAY APPLICATION NO. 8616
AFFECTING THE SW¼NW¼, SEC. 33, TWP.
1S., RGE. 24E., YELLOWSTONE COUNTY,
MONTANA. Sch- 12-29-81

Form R. 48

No. D-7721

RIGHT OF WAY DEED

IN THE NAME AND BY THE AUTHORITY OF THE STATE OF MONTANA

2617

To All To Whom These Presents Shall Come:

Know ye that the State of Montana, in consideration of the sum of----------

----------TWO THOUSAND FIVE HUNDRED AND NO/100----------**Dollars**

now paid, grants to----------THE CITY OF LAUREL----------

a right of way for a----------LANDFILL----------

---

upon and across state lands, as follows:

A tract or strip of land in the SW¼NW¼, Section 33, Township 1 South, Range 24 East, Principal Meridian Montana, Yellowstone County, Montana, more particularly described as follows:

A tract or strip of land of variable width described as follows:

Beginning at a point, said point being 1560.0 feet South of the Northwest Section Corner, Section 33, Township 1 South, Range 24 East, Principal Meridian Montana, and on the Section Line between Sections 32 and 33 lying 62 feet East of said Section Line; said point of beginning being the Southwest Corner of the present Laurel Landfill; said point is on the East Right of Way Line of State Route No. 532; from the point of beginning; thence North 90° 0' 00" East a distance of 700.0 feet to a point, which lies 101.0 feet East of the Southeast Corner of the present Laurel Landfill; thence South 27° 07' 30" East a distance of 700 feet to a point; thence South 90° 0' 00" West a distance of 700 feet to a point, which point lies on the East Right of Way Line of State Route No. 532; thence North 27° 07' 30" West a distance of 700 feet along the East Right of Way Line of State Route No. 532, to the point of beginning

The right of way contains 10.01 acres, more or less.

The grantee shall comply with the Montana Antiquities Act, Title 22, Chapter 3, Part 4 MCA (Title 81, Chapter 25, R.C.M. 1947).

It is also agreed that the grantee will comply with such rules or regulations as may be hereafter imposed by the State Board of Land Commissioners to insure that the environment will be adequately protected and the public health and safety not be endangered.

RIGHT OF WAY APPLICATION NO. 7083
AFFECTING THE W½NW¼, SEC. 33, TWP. 1S,
RGE. 24E, YELLOWSTONE COUNTY, MONTANA.

D.h. 10-24 73

Form R. 48—1M

No. D-6282

RIGHT OF WAY DEED

IN THE NAME AND BY THE AUTHORITY OF THE STATE OF MONTANA

2617

To All To Whom These Presents Shall Come:

Know ye that the State of Montana, in consideration of the sum of ---------- TWO THOUSAND FIVE HUNDRED AND NO/100 ---------- Dollars now paid, grants to ---------- CITY OF LAUREL ---------- a right of way for a ---------- LANDFILL DUMP ----------

upon and across state lands, as follows:

A tract or strip of land in the W½NW¼, Section 33, Township 1 South, Range 24 East, Montana Principal Meridian, Yellowstone County, Montana, more particularly described as follows:

Beginning at a point on the West line and 900 feet South of the Northwest corner of Section 33, Township 1 South, Range 24 East, Montana Principal Meridian; thence East 660 feet; thence South 660 feet; thence West 660 feet; thence North 660 feet to the point of beginning and containing 10 acres.

This right-of-way is granted subject to the following stipulations:

1. Top soil to be removed and stock-piled and then replaced upon completion of the landfill.
2. No more than Five (5) acres to be disturbed at one time without being revegetated.
3. No slope to be left that is greater than 4 to 1.
4. All disturbed area to be revegetated upon abandonment.
5. A mesh wire fence 8 feet high to be maintained at all times at the active pit area. Wire mesh not more than 2 inches by 4 inches.
6. The garbage dump at all time to conform with the Board of Health specifications.

Pat C + P3 —

We need to get this situation resolved one way or another ASAP! whether we accept their analysis on drinking water, give them a NO migration, dump this on WQD for non-deg, or set up a meeting with them in Laurel, let's get this one moving on the fast track.

Do not think
No migration possible.

Jon D

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: DATE: _____

1. _____

2. _____

3. _____

☐ Approval	☐ Comment	☐ Necessary Action
☐ Note and Return	☐ Note and File	☐ Investigate
☐ Prepare reply	☐ Signature	☐ See Me
☐ As requested	☐ For your information	☐ Per Conversation

REMARKS:

FROM: _____

Laurel L.F. Ground water.

FIRE/AMB/POLICE
217 W. 1ST. ST.
PHONE: 628-8737

CITY HALL
115 W. 1ST ST.
PHONE: 628-8791

City of Laurel

P.O. BOX 10
LAUREL, MONTANA 59044

PUBLIC WORKS
DEPARTMENT

November 10, 1994

RECEIVED
NOV 14 1994
Montana Department of Health and Environmental Sciences
Waste Management Division

Ms. Pat Potts
Montana Department of
Health and Environmental Sciences
Waste Management Division
P.O. Box 200901
Helena, Mt. 59620

RE: Status of Groundwater Monitoring Program- Former Laurel Sanitary Landfill

Dear Ms. Potts:

Upon review of your letter to the City of Laurel dated July 20, 1994, we recognize that several issues you presented were directly applicable to the former Laurel Sanitary Landfill. Specifically, it has always been our position that the groundwater at the Laurel Landfill is not a source of drinking water, both locally and regionally, and that the landfill poses no risk to human health and the environment. In order to be sure that the groundwater monitoring program at the Laurel Landfill was heading in the right direction, we contacted another consulting firm (Huntingdon) to review data collected at the site to get another opinion regarding possible sources of groundwater contamination and the severity of the situation. In their letter to us dated September 15, 1994, Huntingdon confirmed what we always suspected; that the quality of the groundwater at the site is naturally poor and that the nitrate measured in the one monitoring well may be related to something other then the landfill.

Based on Huntingdon's conclusions, we felt it would be beneficial for all parties involved to meet here in Laurel to discuss the status of the groundwater monitoring and to visit the site so you could better understand our position. It is truly unfortunate that your office chose to cancel this meeting, with no apparent intention of rescheduling. Mr. Crowley indicated if it was necessary he could possibly come himself, but no one else would be able to make it. It's my understanding the MDHES personnel responsible for requiring additional work at the Laurel Landfill have never visited the site. I would think it would be difficult to make such a rational decision, without visiting the site in question, knowing it may cost a small community thousands of dollars each year for thirty years or more. I believe the data I have submitted to your office, compiled by Huntingdon for the City of Laurel, dated September 15, 1994 and October 26, 1994, will verify my assumption.

In order to better understand the groundwater systems at the Laurel Landfill, we directed Huntingdon to conduct additional research regarding the resource value of the groundwater at the landfill. The result of Huntingdon's most recent work is presented in the attached report. One of the most significant findings presented in the Huntingdon's report is the fact that other researchers found extremely high nitrate concentrations in the groundwater that was sampled from the same geological formation as the one at the Laurel Landfill. The same researchers believe that the nitrates occur naturally and are able to contaminate the groundwater simply by disturbing native sod. It seems obvious to us that this process is possible and maybe responsible for the high nitrate in one monitoring well at the Laurel Landfill, especially since high nitrates levels are not commonly found in landfill leachate. We do not feel it is appropriate to make the City of Laurel spend large amounts of money just to find out where the nitrate originated from, primarily because the groundwater at the landfill is unusable anyway. In fact, the nearest well to the landfill is at the airport, about one mile to the southeast, and they have to haul water because it is undrinkable.

We also agree with Huntingdon's other conclusions regarding the ability of the Colorado shale to supply water to wells. In the Laurel area, it is considered common knowledge that you cannot drill a decent domestic well in shale formations north of Laurel. First of all, it's difficult to get even one gallon a minute from a well (Monitoring wells at the landfill produce about 2 ounces per minute). Secondly, what water you can get is of poor quality. For these reasons, it is our opinion that the water-bearing rocks at the Laurel Landfill are not considered to be aquifers. Therefore, because Montana's groundwater monitoring rules require that the groundwater monitoring system must be designed to "detect groundwater contamination in the uppermost aquifer", we feel it is inappropriate to be required to monitor the shallow groundwater at the landfill. According to Huntingdon, the uppermost aquifer occurs at the depth of approximately 2000 feet below ground surface. Isolated, shallow groundwater in impermeable soil should not be the concern in determining groundwater quality.

With this in mind, it is our opinion that the Laurel Landfill is in a situation where it could be eligible for the No-Migration Demonstration. In accordance with ARM 16.14.714, groundwater monitoring at the facility may be waived by the department if the facility owner or operator can demonstrate there is no potential for hazardous constituents to contaminate the uppermost aquifer. Based on all the data we have collected at the landfill to date, it seems like it would be easy to make this demonstration since there are only trace concentrations of a couple of VOCs in the uppermost groundwater, and the uppermost aquifer is 2000 feet deep.

We would also like to remind you of the history of the Laurel Landfill:

February 1990:	The City of Laurel first requested a transfer site and stated the Type II waste will be hauled to the Billings Landfill, however the MDHES personnel told the City not to start the process of closing the existing landfill until after May 1990 when the regulations come out.
March 26, 1990:	MDHES recommended approval of the transfer site and closing of the landfill however, no assistance or direction was given.
April 3, 1991:	MDHES sent a general guidance policy for closure, however, the rules still would not be adopted until months later.
November 5, 1991:	The City of Laurel received a letter from MDHES stating, due to the city not meeting final closure requirements by October 9, 1991, the city must pay new landfill fees, even though the rules are not written. The City of Laurel contacted a hydrogeological firm, in 1991, to begin the process identified in the general guidelines.
May 8, 1992:	MDHES sent the City of Laurel a very direct letter indicating a work plan MUST be submitted in 90 days.
June 9, 1992:	A letter from MDHES indicated the City of Laurel, had missed the April 30, 1992 deadline for the transfer site review, however, MDHES's letter dated May 8, 1992 required the renewal by June 30, 1992.
August 1992:	The City of Laurel requested an extension to submit the closure plan, the City Engineer suffered two strokes and the city didn't have staff to complete the process, MDHES granted a 30 day extension.
1992-1993:	The City of Laurel's consultant worked with MDHEs personnel reviewing and evaluating available data.

February 1, 1994: Your office informed the City of Laurel that a complete resampling and testing was required within 60 days from the date of your letter. The testing would require Table I, Table II, and eight additional tests. The requirement would put the city of Laurel into assessment monitoring. Justification as stated in your February 1, 1994 letter was that the City of Laurel's Landfill has test results that are getting dangerously close to designated limits and the number of, and concentrations of, VOC's are increasing.

July 28, 1994: The City of Laurel's consultant (Geo Research) wrote a letter to the City indicating the MDHES letter of July 20, 1994 mandates the City of Laurel to move into corrective action.

At that point in time, the City of Laurel determined it was necessary to obtain a second opinion, and contracted with Huntingdon to review the situation. Huntingdon submitted their professional opinion on September 27, 1994, which I forwarded to your office on September 27, 1994. Please consider this letter, with enclosure, as a followup to my September letter due to your cancellation of the scheduled meeting on October 19, 1994, and the City of Laurel not receiving any response from your office.

To summarize, I believe Huntingdon's two letters dated September 15, 1994 (previously sent to you) and the enclosed letter dated October 26, 1994, makes it apparent a true assessment of the Laurel Landfill has not previously been accomplished. MDHES cancellation of the pre-approved meeting to resolve these concerns was very unfortunate. The City of Laurel wants to move ahead on this matter and encourages your support and willingness to review all the data that directly effects this site.

Sincerely,

James A. Flisrand

James A. Flisrand
Director of Public Works

JF/cl
Enclosure
cc: Robert Robinson/Director/Dept. of Health and Env. Sciences
Roger Thorvilson/Waste Management Division Administrator
Jon Dillard/Solid Waste Program Manager
Pat Crowley/Solid and Hazardous Waste Specialist

Huntingdon

Chen-Northern, Inc.

1610 B Street
Box 4699
Helena, Montana 59604
(406)443-5210
Fax: (406)449-3729

October 26, 1994

Mr. Jim Flisrand
Public Works Director
City of Laurel
115 West First
Laurel, Montana 59044

RE: Summary of Hydrogeological Conditions at and Near the Laurel Sanitary Landfill

Dear Mr. Flisrand:

Personnel from Huntingdon Engineering and Environmental, Inc. (Huntingdon) prepared this letter report for the City of Laurel in accordance with work elements described in Task Order No. 1 of the Professional Services Agreement between the City of Laurel and Huntingdon dated September 19, 1994 and in response to your verbal request for such a report on October 17, 1994. The primary purpose of this letter report is to summarize hydrogeological conditions at and near the former Laurel Sanitary Landfill from which interested parties can assess the resource value of water-bearing geological formations at the landfill. Information presented in this report supplements that presented to the City of Laurel in a letter report submitted to Mr. Chuck Rogers, Mayor of the City of Laurel, on September 15, 1994 by Huntingdon and hydrogeological data reported by GeoResearch, Inc. from May, 1993 through August, 1994.

For the sake of brevity, information presented in this report focuses on the natural quality of groundwater inherent to geological formations present at and near the Laurel Sanitary landfill and the ability of those geological formations to transmit water. Descriptions of physical characteristics of the site (e.g. topography, climate, land use, etc.) have been documented in previous reports prepared by GeoResearch.

GEOLOGY

The former Laurel Sanitary Landfill is located approximately two miles north of Laurel (Figure 1, attached). According to Gosling and Pashley (1973), surficial deposits at the former Laurel Sanitary Landfill consist of Quaternary-age slope wash deposits. Based on our review of lithologic logs for five monitoring wells installed at the former Laurel Sanitary Landfill (Figure 2, attached), the slope wash deposits consist of lean clay ranging in thickness from 6 to 12 feet. Slope wash deposits overly shale bedrock of the Niobrara Formation (Balster, 1971) which is the upper-most formation of the Colorado Group. The Niobrara Formation consists of a dark gray to black marine shale that yields little to no water (Hall and Howard, 1929). Occasional thin beds of bentonite and sandstone are present throughout the Colorado shale; however, the sandy beds are generally dry or contain water of very poor quality (Hall and Howard, 1929).

Uppermost groundwater occurs beneath the site at depths ranging from approximately six feet below ground surface near well MW-1 to 29 feet below ground surface near well MW-4. Monitoring well MW-2D, located immediately adjacent to well MW-2, penetrates a deeper water bearing unit. Depth to groundwater in the deeper water-bearing unit is approximately 30 feet below ground surface near well MW-2D.

The relative inability of the Colorado shale to yield water to wells is exemplified by recovery rates measured in monitoring wells installed at the former Laurel Sanitary Landfill. Based on data obtained by GeoResearch during May, 1994, the rate of recharge to monitoring wells at the former Laurel Landfill range from 0.0056 to 0.017 gallons per minute. Additional data collected by GeoResearch indicated that it required more than two weeks for the water level in monitoring well MW-2D to recovery to equilibrium after the well was installed an developed.

The Colorado group is approximately 2,000 feet thick in the Laurel area and is underlain by the Cloverly Formation. The Cloverly Formation corresponds to the Kootenai Formation to the north and west of Laurel. The Cloverly Formation consists of massive conglomeritic sandstone and serves as the upper-most geological formation in the area that is capable of yielding potable groundwater to wells (Hall and Howard, 1929).

HYDROLOGY

The nearest active surface water system to the former Laurel Sanitary Landfill is the Cove Ditch, a manmade irrigation canal located approximately one mile to the south. The Yellowstone River is the nearest natural surface water system to the former Laurel Sanitary Landfill, located approximately four miles to the south. A spring emanates approximately one half mile north of the site and an area exhibiting efflorescence occurs immediately south of the site. Efflorescence typically indicates groundwater seepage of highly mineralized water (saline seep).

WATER QUALITY

Selected water quality data for groundwater samples collected from monitoring wells MW-1, MW-2, MW-2D, MW-3, and MW-4 (Figure 2, attached) at the Laurel Sanitary Landfill are presented in Table 1. Also included in Table 1 are water quality data obtained from several other monitoring wells that were installed and sampled in conjunction with saline-seep investigations completed northwest of the former Laurel Sanitary Landfill (Lewis et. al., 1979 and Duaime et. al., 1991). Wells denoted as Lewis-1 and Lewis-2 are shallow wells (less than 20 feet deep) completed in the Niobrara Formation at a study site located approximately 30 miles northwest of the former Laurel Sanitary Landfill. Well B-1 is a 23-foot deep monitoring well completed in the Colorado shale approximately 15 miles northwest of Laurel.

TABLE 1
SUMMARY OF SELECTED GROUNDWATER QUALITY DATA
LAUREL SANITARY LANDFILL

Parameter	MCL	MW-1 Downgradient	MW-2 Downgradient	MW-2D Downgradient (deep)	MW-3 Downgradient	MW-4 Upgradient	Lewis-1 [2]	Lewis-2 [3]	Z-1 [4]
Sulfate	250 [1]	23,900	12,200	93	22,900	4,610	2,760	1,810	14,700
Chloride	250 [1]	197	192	3,000	350	132	302	205	1,460
Sodium	NE	4,400 [5]	2,350 [5]	NA	1,020	987	460	395-400 [6]	4030
TDS	500 [1]	23,900	24,900 [4]	NA	35,700 [5]	8,900 [5]	NA	NA	NA
Nitrate	10	<0.05	52.8	<0.05	0.21	3.31	76	172-33 [6]	91.0
Chemical Oxygen Demand	NE	422	144	267	426	406	NA	NA	NA

Notes: All data obtained from monitoring wells at the former Laurel Sanitary Landfill are from the May, 1994 monitoring event unless otherwise noted.
All units in milligrams per liter (mg/l).
MCL = Maximum Contaminant Level
NE = None established
NA = Not Analyzed
[1]Secondary Standards, 40 CFR Part 143 (Federal Register, Vol. 44, No. 140, July 19, 1979).
[2]Well No. 04N20E36CCBC (Lewis et. al., 1979).
[3]Well No. 04N21E32ABAA (Lewis et. al., 1979).
[4]Well Z-1 (Duaime et. al., 1991).
[5]May, 1993 Data.
[6]June, 1975 and August, 1975 data, respectively.

It is evident from review of Table 1 that the quality of groundwater in the upper-most water bearing unit upgradient from the Laurel Sanitary Landfill is very poor. Sulfate, total dissolved solids (TDS), and chloride in upgradient well MW-4 have been measured at concentrations of 4,610, 8,900, and 302 milligrams per liter (mg/l), respectively. Concentrations of each of these parameters exceed secondary drinking water standards established by the U.S. EPA. Comparison of water quality data from well MW-4 to those data obtained from shallow wells at other sites northwest of Laurel indicate that it is not uncommon for shallow groundwater within the Colorado shale to exhibit high concentrations of sulfate, chloride, and TDS.

It is further evident from review of Table 1 that groundwater in the next deepest water-bearing unit (that intercepted by well MW-2D) is of poor quality. Chloride concentrations as high as 3,300 mg/l have been measured in water sampled from well MW-2D. It is unlikely that the elevated chloride measured in well MW-2D is related to the landfill because chloride concentrations in water obtained from shallow wells at the landfill are generally an order of magnitude less than that measured in the deeper well. We attribute the high chloride measured in water sampled from well MW-2D to natural water quality conditions inherent to marine shale deposits of the Colorado Group. This is supported by water quality data obtained by other investigators conducting studies in the area. As presented on Table 1, elevated chloride concentrations have been measured in monitoring wells completed in marine shale formations (well Z-1, Duaime, et. al., 1991) at other project sites near Laurel.

Of noteworthy significance are concentrations of nitrate measured in groundwater samples collected at the saline-seep investigation sites. Both Lewis et. al. (1979) and Duaime et. al. (1991) measured elevated nitrate concentrations in water samples collected from shallow monitoring wells completed in marine shale. Lewis et. al. (1979) measured nitrate in shallow groundwater as high as 855 mg/l while Duaime, et. al. measured nitrate as high as 107 mg/l. Custer (1976) attributes the elevated nitrate concentrations in shallow groundwater at the sites to conversion of organic nitrogen present in the A soil horizon to nitrate by micro-organisms in response to increased aeration and moisture content due to cultivation of native sod.

Three volatile organic compounds have been measured in water samples collected at the former Laurel Sanitary Landfill. VOC data obtained at the Laurel Sanitary Landfill during the most recent groundwater monitoring event (April/May, 1994) are summarized in Table 2.

Dichlorodifluoromethane has been measured in samples collected from well MW-2 at concentrations ranging from 4.3 to 9.4 micrograms per liter (μg/l). Dichlorodifluoromethane (CFC-12) is a highly volatile compound that is used as a refrigerant and aerosol propellant (Merck, 1983). It is a colorless, non-corrosive, non-irritating gas that has little, if any, anesthetic or toxic action (Merck, 1983). Because of the volatility of CFC-12, it is likely that the compound is introduced to groundwater beneath the former Laurel Sanitary Landfill by the condensation of landfill gas on the water table. For this reason, it is unlikely that concentrations of CFC-12 would increase significantly over

time. Rather, concentrations of CFC-12 in shallow groundwater at the site would likely decrease as the landfill progressively generates less gas.

TABLE 2
SUMMARY OF SELECTED VOLATILE ORGANIC COMPOUND DATA
FORMER LAUREL SANITARY LANDFILL

PARAMETER	MCL[1]	WQB-7[2]	MW-1	MW-2	MW-2D	MW-3	MW-4	Field Blank
Dichlorodifluoromethane	NA	6,900	<1	9.4	<1	<1	<1	<1
Trichlorofluoromethane	NA	10,000	<1	2.6	<1	<1	<2	<1
Methylene Chloride	5	4.7	<1	1.5	<1	<1	<1	5.7

Notes: All units in micrograms per liter (μg/l).
MCL = Maximum Contaminant Level.
WQB-7 = Human Health Standards from Montana Numeric Water Quality Standards (Circular WQB-7).

Trichlorofluoromethane (CFC-11) has been measured in samples collected from well MW-2 at concentrations ranging from 1.4 to 2.6 μg/l. Trichlorofluoromethane is also a highly volatile compound that is used as a refrigerant and aerosol propellant. It is practically insoluble in water and is less toxic than carbon dioxide (Merck, 1983). Because of its volatility, the fate of CFC-11 in groundwater at the former Laurel Sanitary Landfill is likely to be similar to that described for CFC-12.

Methylene chloride has been measured at concentrations ranging from below detection limits to 2.7 μg/l in monitoring well MW-2. Methylene chloride has also been measured in equipment blank samples on a number of occasions at concentrations as high as 7.5 μg/l. Because methylene chloride has been measured in equipment blanks and field blanks during four monitoring events and is a common laboratory contaminant (USEPA, 1988), it appears that methylene chloride concentrations reported for water samples collected at the landfill are not likely related to the landfill.

CONCLUSIONS

Based on our review of site-specific data obtained at the former Laurel Sanitary Landfill and data published by researchers conducting other hydrogeological investigations in the area, we offer the following conclusions regarding the resource value of water-bearing geological formations at and near the Laurel Sanitary Landfill and the impacts of the landfill on underlying groundwater:

- Shale formations of Colorado Group rocks yield little water to wells. The lack of use of the Colorado Group as an aquifer for domestic, stock watering, or irrigation purposes in the area is well documented.

- Groundwater hosted by shale formations of the Colorado Group is

mineralized and in general, is unsuitable for domestic, stock watering, or irrigation purposes. This conclusion is supported by the fact that several saline-seep investigations have been completed near the former Laurel Landfill and areas exhibiting saline seep exist immediately south of the site.

- Other researchers (Lewis et. al., 1979 and Duaime et. al., 1991) have documented elevated concentrations of nitrate in shallow groundwater hosted in similar geological formations as that present at the Laurel Sanitary Landfill. Nitrate concentrations ranging as high as 855 mg/l have been measured in water samples collected from shallow monitoring wells completed in the same geological formation as that penetrated by monitoring wells at the former Laurel Sanitary Landfill (Lewis et. al., 1979). These data suggest that it is possible that the elevated nitrates measured in well MW-2 at the former Laurel Landfill are not related to historic landfilling activities. This premise is further supported by the general understanding that nitrate is not considered to be a typical indicator parameter for landfill leachate. Landfill leachate is typically generated by the anaerobic decomposition of wastes that result in reducing conditions (Bagchi, 1990). Therefore, nitrogen is usually present in landfill leachate as ammonia rather than nitrate. Elevated ammonia concentrations have not been measured in any water samples collected from well MW-2.

- Two VOCs (CFC-12 and CFC-11) have been measured in groundwater downgradient from the facility that appear to be related to the landfill. Each of these VOCs are present at concentrations several orders of magnitude less than human health standards established by Montana. Because of the relative volatility and insolubility of these compounds, it is unlikely that they will be measured at significantly greater concentrations with time.

- Methylene chloride has consistently been measured in field blank and equipment blank samples throughout the history of groundwater monitoring at the landfill. For this reason and the fact that methylene chloride is a common laboratory contaminant, it is unlikely that its presence in groundwater is related to the landfill.

Please do not hesitate to contact me if you have any questions regarding information presented herein.

Sincerely,

Pat Dunlavy

Patrick Dunlavy
Senior Hydrogeologist

Attachments

REFERENCES

Bagchi, A., 1990. Design, Construction, and Monitoring of Sanitary Landfill. John Wiley & Sons.

Balster, C.A., 1971. Catalogue of Stratigraphic Names for Montana. Montana Bureau of Mines and Geology, Special Publication No. 54.

Custer, S. G., 1976. The nitrate problem in areas of saline-seep -- A case study, in Regional Saline Seep Symposium Proceedings, Bozeman, Montana, 1975: Cooperative Extension Service, Montana State University Bulletin 1132.

Duaime, T. E., Metesh, J.J., Miller, M.R., Moore, H. R., and Bergantino, A. R., 1991. Impacts on Water Quality from Plow-Out and Saline-Seep Reclamation Practices, Stillwater County, Montana. Montana Bureau of Mines and Geology Open file Report No. 242.

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Gosling, A. W. and Pashley, E. F., 1973. Water Resources of the Yellowstone River Valley, Billings to Park City, Montana. U.S. Geological Survey, Hydrologic Investigations Atlas HA-454.

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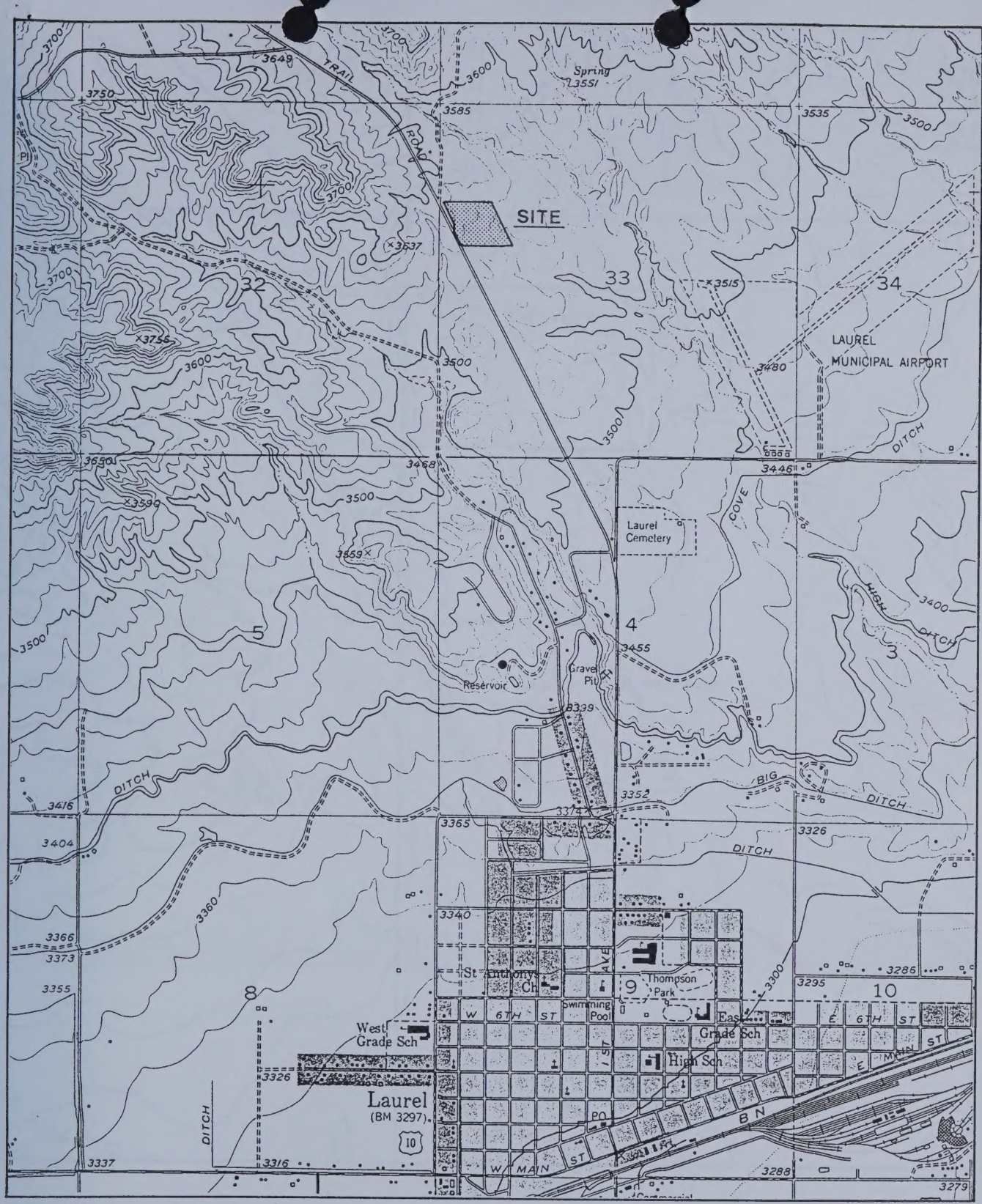
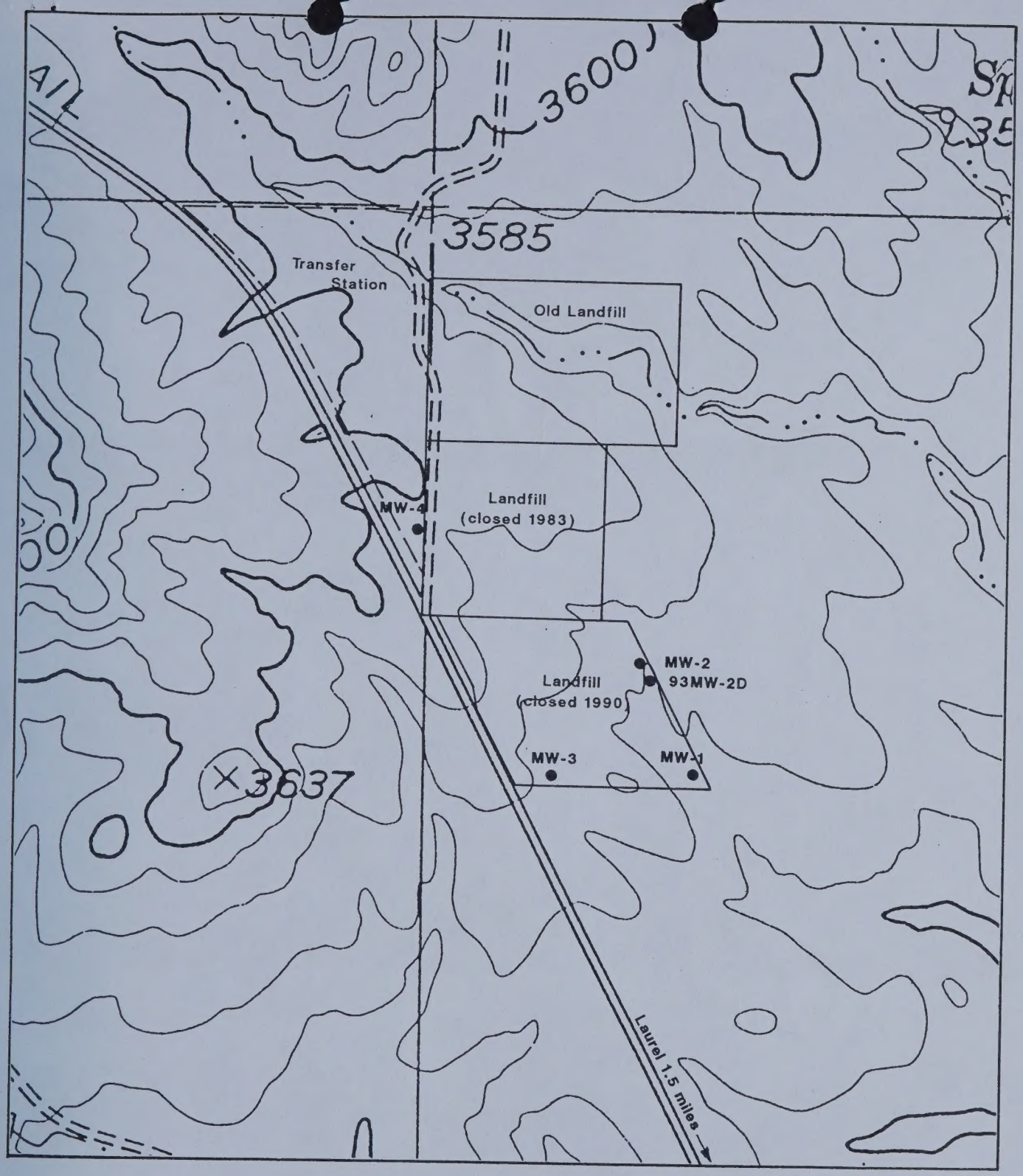


From USGS 7.5' Laurel Quad

Yellowstone County, Montana

Location Map
City of Laurel Landfill
Laurel, Montana
FIGURE 1

HE&E 94-3754



● Monitoring Well

500 Feet

Site Map
City of Laurel Landfill
Laurel, Montana
FIGURE 2

HE&E 94-3754

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proof CU

DATE: 10/5/94

1. Pat C, PPC
2. Roger T RT
3.

- [x] Approval
- [ ] Note and Return
- [ ] Prepare reply
- [ ] As requested
- [ ] Comment
- [ ] Note and File
- [ ] Signature
- [ ] For your information
- [ ] Necessary Action
- [ ] Investigate
- [ ] See Me
- [ ] Per Conversation

REMARKS:

Please let me know the acceptable date & time for this requested meeting @ Lamel.

sw\yellaur.rsp

FROM: P3

FIRE/AMB/POLICE
217 W. 1ST. ST.
PHONE: 628-8737

CITY HALL
115 W. 1ST ST.
PHONE: 628-8791

City of Laurel

P.O. BOX 10
LAUREL, MONTANA 59044

DEPARTMENT

September 27, 1994

Pat Potts
Environmental Specialist
Waste Management Division
P.O. Box 200901
Helena, Mt. 59620

Dear Pat:

In reviewing all of the data from the Laurel landfill, and the opinion from Huntingdon, Chen Northern, which is enclosed for your review, the City of Laurel respectfully requests an opportunity to meet with the Waste Management Division and discuss the direction you have indicated the City of Laurel must take with the landfill.

The City of Laurel is a small community and doesn't have the capabilities of funding an extended exploratory monitoring program to continue proving that the up gradient and down gradient wells naturally consist of non potable water. Considering the location of the landfill and the nearest domestic well, I believe we need to discuss reasonable solutions.

I respectfully request an extension on all requirements you have set for the City of Laurel until after our meeting. To fully evaluate the concerns of this community it will be necessary to meet in Laurel with a tour of the landfill.

The City of Laurel intends to have Administrative and staff personnel, Huntingdon personnel, and elected State and, if available, U.S. Representatives present. We request a minimum of the following personnel from your Division: Roger Thorvilson, Acting Division Administrator; Jon Dilliard, Program Manager Solid Waste; yourself and Steve Pilcher, Acting Division Administrator of the Water Quality Division.

We are currently planning on the week of October 17, 1994. Please notify Mayor Chuck Rodgers, City of Laurel, P.O. Box 10, Laurel, Montana 59044 if you have any immediate concerns or questions.

sincerely,

James A. Flisrand

James A. Flisrand
Director of Public Works

cc:
Roger Thorvilson, Acting Division Administrator
Jon Dilliard, Program Manager Solid Waste
Chuck Rodgers, Mayor
State Representatives
City Attorney
File

Huntingdon
Consulting Engineers Environmental Scientists

Chen-Northern, Inc.
1610 B Street
Box 4699
Helena, Montana 59604
(406) 443-5210
Fax (406) 449-3729

September 15, 1994

Mr. Chuck Rogers, Mayor
City of Laurel
P.O. Box 10
Laurel, Montana 59044

RE: Review of Hydrogeological and Groundwater Quality Data -- Laurel Sanitary Landfill

Dear Mr. Rogers:

At the request of Mr. Jim Flisrand, we reviewed selected correspondence, hydrogeological reports, and groundwater quality data associated with the groundwater monitoring program at the former Laurel Sanitary Landfill. Mr. Flisrand requested that we review this information and describe findings of our review to the City of Laurel because, apparently, there is concern that the landfill has impacted groundwater at the site to a degree that warrants corrective action.

Our knowledge of specific geological and hydrogeological characteristics of the site is limited because we have not had an opportunity to visit the site or review lithologic logs for borings drilled at the landfill. Because of this, comments provided below consist of general conclusions that we are able to draw from the information provided to us, with specific attention given to the regulatory compliance status of the landfill.

WATER QUALITY

Mr. Flisrand provided us a copy of the groundwater quality data base for the Laurel Landfill. We do not have copies of actual laboratory analytical reports. Therefore, comments provided in this section are based solely on our review of the data base printout and on information contained in correspondence provided by Mr. Flisrand.

Based on information contained in the MDHES letter to the City of Laurel dated April 5, 1994, nitrate concentrations in samples collected from well MW-2 appear to have generated the most concern regarding impacts to groundwater at the site. It is obvious that concentrations of nitrate in samples collected from well MW-2 are elevated with respect to all other wells at the site. Nitrate concentrations at well MW-2 have ranged from 51 to 55 milligrams per liter (mg/l) while nitrate concentrations in all other wells have ranged from below detection limits to 3.3 mg/l. However, our general opinion of the relatively high nitrate concentrations at well MW-2 is that the nitrate is not related to landfill leachate for the following reasons:

- Nitrate is not considered to be a typical indicator parameter for landfill leachate. Landfill leachate is typically generated by the anaerobic

decomposition of wastes that result in reducing conditions (Bagchi, 1990). Therefore, nitrogen is usually present in landfill leachate as ammonia rather than nitrate. Ammonia concentrations have not been elevated in any water samples collected from well MW-2. MDHES supports this premise in their letter to the City of Laurel dated April 5, 1994.

- Based on our experience at other landfills in Montana where leachate is known to have impacted groundwater, nitrate concentrations are relatively low while ammonia concentrations are relatively high.

The fact that elevated nitrate concentrations have not been measured in downgradient wells MW-1 and MW-3 indicates that there is/was an isolated source for nitrate near the landfill. Apparently, sludge from Laurel's waste water treatment plant had been stockpiled at the landfill and later moved to another location. Past agricultural activities in the area (e.g., feed lots, fertilizer applications, etc.) may also be a source of the nitrate measured at well MW-2. It is our opinion that the source of nitrate must be identified before it can be determined if there is a need to complete an assessment of corrective measures.

From review of their letter to the City of Laurel dated April 5, 1994, it is apparent that MDHES is also concerned about several volatile organic compounds (VOCs) measured in selected wells. Specifically, MDHES is concerned about dichlorodifluoromethane, methylene chloride, trichlorofluoromethane, and 1,1,1-trichloroethane. Based on review of the groundwater quality data base provided by Mr. Flisrand, we offer the following:

- Dichlorodifluoromethane has apparently been measured in samples collected from well MW-2 at concentrations ranging from 4.3 to 9.4 micrograms per liter (μg/l). Because dichlorodifluoromethane is highly volatile, we suspect that the trace concentrations of dichlorodifluoromethane present in well MW-2 are related to landfill gas rather than landfill leachate. The USEPA has not established an MCL for dichlorodifluoromethane. Therefore, based on our interpretation of the Administrative Rules of Montana, Title 16, Chapter 14, Subchapter 7, Section 8, Parts 3 and 4 (ARM 16.14.708(3) and (4)), regulatory actions are not required.

- Methylene chloride has been measured at concentrations ranging from below detection limits to 2.7 μg/l in monitoring well MW-2. Methylene chloride has also been measured in equipment blank samples on a number of occasions at concentrations as high as 7.5 μg/l. Because methylene chloride has been measured in equipment blanks during several monitoring events and because methylene chloride is a common laboratory contaminant (USEPA, 1988), it is our opinion that methylene chloride concentrations reported for samples from well MW-2 are likely not related to the landfill.

- Trichlorofluoromethane has been measured in samples collected from well MW-2 at concentrations ranging from 1.4 to 2.6 μg/l. Trichlorofluoromethane is a highly volatile compound (similar to dichlorodifluoromethane), and therefore, we suspect that its presence at well MW-2 is likely related to landfill gas rather than leachate. The USEPA has not established an MCL for trichlorodifluoromethane, and therefore, regulatory actions would not be required at the Laurel Landfill because of the presence of this VOC.

- Based on our review of the laboratory data base, 1,1,1-trichloroethane has not been detected in any water samples collected at the landfill at concentrations above the practical quantitation limit.

Further review of the groundwater quality data base indicates that the former Laurel Sanitary Landfill is situated in an area that, because of the geological environment, is characterized by very poor quality water. Groundwater intercepted by upgradient well MW-4 has total dissolved solids concentrations of 8,900 mg/l and sulfate concentrations of 5,560 mg/l. Secondary drinking water standards for these two parameters are 250 mg/l and 500 mg/l, respectively (40 CFR Part 143, July 19, 1979). In addition, monitoring well MW-2D, which is apparently completed in the second deepest water-bearing zone, intercepts groundwater that has chloride concentrations in excess of 3,000 mg/l. The secondary drinking water standard for chloride is 250 mg/l (40 CFR Part 143, July, 1979). Therefore, given the natural quality of groundwater at the site, it is highly unlikely that the two upper-most water-bearing units at the facility would ever be used as a source of drinking water.

REGULATORY COMPLIANCE STATUS

We understand that the MDHES is requesting that the City of Laurel conduct an assessment of corrective measures for the landfill. Based on our understanding of ARM 16.14.708, an assessment of corrective measures is required for any landfill where one or more Table 2 (ARM 16.14.706) parameter(s) is/are detected at statistically significant concentrations above a groundwater protection standard. Although we have not statistically evaluated groundwater quality data obtained at the Laurel Sanitary Landfill, it is highly probable that nitrate concentrations in well MW-2 are at statistically significant levels above the MCL for nitrate. However, because nitrate is not listed as a Table 2 parameter in ARM 16.14.706, an assessment of corrective measures should not be required based on the presence of nitrate in this well. Further, VOCs have never been detected in any water samples at concentrations that exceed a MCL, so VOCs are not present at statistically significant concentrations above an enforcement standard.

ARM 16.14.708(7)(e) states that MDHES may determine that remediation of a release of a Table 2 [ARM 16.14.706] constituent from a disposal unit is not necessary if the owner or operator demonstrates to the department that :

(i) The groundwater is additionally contaminated by substances that have originated from a source other than a disposal unit and those substances are present in concentrations that cleanup of the release from the disposal unit would provide no significant reduction in risk to actual or potential receptors; or
(ii) The constituent(s) is present in groundwater that:
(A) Is not currently or reasonably expected to be a source of drinking water; and
(B) Is not hydraulically connected with waters to which the hazardous constituents are migrating or are likely to migrate in a concentration(s) that would exceed groundwater protection standards.

Because of the natural quality of groundwater at the site in the two upper-most water-bearing units at the Laurel Landfill, it is highly unlikely that groundwater at the site will ever be used as a source of drinking water. Therefore, even if remediation of elevated nitrate concentrations near well MW-2 is successful, the two upper-most water-bearing units near the landfill would not be considered to be a source of potable water. It is our opinion that the City of Laurel should pursue this line of reasoning in negotiating a resolution of this issue with the MDHES rather than spend additional money attempting to determine the source of nitrates at the landfill or evaluate remediation technologies for nitrate remediation.

Sincerely,

Patrick Dunlavy
Senior Hydrogeologist

REFERENCES

Bagchi, A., 1990. Design, Construction, and Monitoring of Sanitary Landfill. John Wiley & Sons.

USEPA, 1988. Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses. Prepared for the Hazardous Site Evaluation Division, U.S. Environmental Protection Agency.

CLOSED
LAUREL LANDFILL
LICENSE NUMBER 203

GEORESEARCH

ANNUAL REPORT, GROUNDWATER MONITORING ACTIVITIES (MAY '93 - MAY '94)

AUGUST 1994

IS LOCATED IN THE GROUNDWATER MONITORING REPORTS ARCHIVE, BOX NUMBER 8

RECEIVED 8/2/1994

GeoResearch, Inc.

GEO RESEARCH®

August 1, 1994

RECEIVED
AUG 0 2 1994
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

Ms. Pat Potts
MT Dept. of Health
& Environmental Sciences
Solid Waste Program
2209 Phoenix Avenue
P. O. Box 200901
Helena, MT 59620

Re: 1993 - 1994 Annual Report of Groundwater Monitoring at City of Laurel Landfill, Montana (License No. 203)

Dear Ms. Potts:

On behalf of our client, the City of Laurel, Montana, GeoResearch, Inc., wishes to submit three copies of the subject report to the Department and place the same into the operating record for the facility. The contents of the report were prepared in accordance with and the intent to comply with ARM 16.14.707(1)(a) and -709. Copies of analysis reports for previous sampling activities are not included with the report. References to correspondence and other documents transmitting the lab reports are provided in Section 8.0 of the report.

A separate Groundwater Monitoring Plan (i.e., ARM 16.14.707(1)(b) and -711 for the facility has not been prepared. However, a Sampling and Analysis Plan and Quality Assurance Plan were included and submitted with the Post-Closure Plan (dated February 3, 1994) for this facility. The latter Plan was submitted just prior to receipt of the Departments February 1st letter placing the facility on Assessment Monitoring. The sampling procedures described in the Soils and Hydrogeologic Study (February 1994) were followed during performance of the Spring and Fall 1993 Detection Monitoring while those contained in the Post-Closure Plan were employed during the Spring 94 Assessment Monitoring activity. During the Spring 94 sampling event, the complete Table 2 list of constituents were analyzed in place of all references to Table 1 in the Post-Closure Plan.

115 North Broadway
Billings, MT 59101
TEL. (406) 248-6771
FAX (406) 248-6770

If required by the Department, a stand alone Groundwater Monitoring Plan essentially following the procedures outlined in the Post-Closure Plan may be prepared prior to the next semi-annual sampling event scheduled for November, 1994. The plan would be updated to reflect current assessment monitoring requirements and corrective measures imposed at the landfill. Please inform the City if preparation of a separate Plan will be necessary, or if modifications to other existing Plans will suffice to comply with ARM 16.14.707(1)(b) and -711.

If you have any questions or comments concerning the subject report, please contact me in our Billings office.

Sincerely,

James D. Shaffer
Sr. Hydrogeologist

Enc: Annual Report (1993-1994 Groundwater Monitoring Activities)

cc: D. Michael, Engineer, City of Laurel (w/enc)
C. Rogers, Mayor, City of Laurel (w/ enc)

CLOSED
LAUREL LANDFILL
LICENSE NUMBER 203

GEORESEARCH

LABORATORY RESULTS OF SPRING 1994
ASSESSMENT MONITORING

JUNE 1994

IS LOCATED IN THE GROUNDWATER
MONITORING REPORTS ARCHIVE,
BOX NUMBER 8

RECEIVED 6/28/1994

GeoResearch, Inc

March 10, 1994

Mr. David Michael
City of Laurel

FAX COVER SHEET

OUTLOOK PUBLISHING, INC.

FAX NO.: 1-444-1499 DATE: 3/31/94

TO: Montana Department of Health and Environmental Sciences

ATTENTION: Pat Potts

SUBJECT: GeoResearch report

SENDER:

NUMBER OF PAGES: COVER SHEET + 6 = 7 PAGES

IF ALL PAGES NOT RECEIVED, CALL 406-628-4412

During operation of license No. 24, surface water runon reportedly accumulated or "ponded" in a localized area at the extreme northeast corner of license No. 203. This "ponding" area may have acted as a deposition site for nitrate-containing sediments transported in runoff from license No. 24. Runoff associated with the former pig farm is not clearly documented, and may have occupied the same general surface route; however, "ponding" is not known to have occurred.

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Billings, MT 59101
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GeoResearch, Inc.

GEO RESEARCH

March 10, 1994

Mr. David Michael
City of Laurel
P. O. Box 10
Laurel, MT 59044

Re: 1) Results of Soil Sampling and Analysis for Nitrates, and
2) Task Orders 6a and 6b at the
City of Laurel Landfill License Nos. 24 and 203

Dear Mr. Michael:

Following our meeting of February 22, at the request of the Garbage Committee for the City of Laurel, GeoResearch, Inc., conducted near-surface and shallow depth sampling of soils at selected locations within the subject license areas. Sampling was conducted on March 1. A total of 14 soil samples were collected at depths ranging from three-inches to 21-inches below the graded land surface. The attached figure shows the location of the sampling locations. At the request of the City, all samples were analyzed for nitrates (EPA method 353.2) on an expedited lab turnaround basis. The results of the testing were received by GeoResearch on Friday, March 4.

History of Nitrates and Drainage at the Landfill:

Several historical activities have been conducted on the subject sites which may be considered sources or contributors to the levels of nitrates detected in groundwater monitoring well MW-2. Activities at the site have included the operation of a pig farm and holding pens near the existing container/transfer site, and the addition of dried sewage sludge as an amendment to the soil cap placed on license No. 24. During operation of license No. 24, surface water runoff reportedly accumulated or "ponded" in a localized area at the extreme northeast corner of license No. 203. This "ponding" area may have acted as a deposition site for nitrate-containing sediments transported in runoff from license No. 24. Runoff associated with the former pig farm is not clearly documented, and may have occupied the same general surface route; however, "ponding" is not known to have occurred.

115 North Broadway
Billings, MT 59101
TEL. (406) 248-8771
FAX (406) 248-8770

As you stated during the site visit of February 28, the "ponding" site has been reconfigured and sediments buried, but not removed, in conjunction with soil capping and compacting at license No. 203. Several committee members who were formerly employed at the landfill during that time have indicated that the application of sludge as a soil amendment was not practiced on license No. 203. Where applied on license No. 24, sludge was dumped on the surface and spread by means of a grader/scraper. This method of application probably resulted in a varying thickness and uneven distribution and in some places may be entirely lacking. On license No. 24, runoff from precipitation and uptake by the established vegetation may have further acted to remove or reduce the level of nitrates now present in soils.

Previous and existing drainage character at the landfill is such that runoff from license Nos. 24 and/or 203 does not extend significantly, if at all, across the other. Runoff from the south half of No. 24 and approximately the extreme northern one-third of No. 203 may commingle in the vicinity of the former "ponding" area before continuing to drain to the southeast and passing in the vicinity of wells MW-2 and 93MW-2D.

Sampling Objectives:

Sampling and analysis of the soils at the landfill were conducted in an attempt to characterize the level of nitrates present in: 1) the near-surface and shallow soils above any buried waste; 2) those areas which drained and may have accumulated in the northeast corner of license No. 203; and, 3) areas that appear to now drain through the same area as a result of the established surface topography.

Sampling and analysis of soils were initially planned at depths within the expected average root depth, i.e., 3 to 6 inches and from 21 to 24 inches. Comparison of the test results on a depth and location basis, was expected to suggest horizontal and vertical (migration or leaching) distribution of nitrates, and the potential for license No. 24 as a source of nitrates detected in the groundwater at MW-2. Sampling and analysis of soils in the "ponding" area and up slope of the site were conducted to provide information on the "ponding" site as a potential nitrate source.

Vadose water or groundwater was not collected or encountered during the sampling activities. However, below 6 inches, the soil was frozen at several of the locations. At several locations, buried waste was encountered at less than 21 inches depth and sampling was performed at depths less than originally planned. All samples were collected above any landfill waste encountered. All samples were planned to be three inches in length at depths of 3 and 21 inches. Please refer to the sample location map included as an attachment to this letter.

Evaluation of Analysis Results:

Sample identification numbers (e.g., 24-BN+40+03) provide information as to the landfill license number on which the sample is positioned, its location, and depth. The first number of the sample, either "24" or "203" indicate the license number; the letters "BN" indicates the sample is located at the approximate boundary of the two licenses. The single letter "B" indicates the sample is located north of the "BN" location. The number "+40" or "+80" designate the number of average stride lengths (paces) from the "BN" location. Sample sites south of the "BN" location do not contain an alphabetic character in the sample number. The alphanumeric symbols "P1" or "P2" designate samples collected in the vicinity of the former "ponding" area. The P1 and P2 sites are separated by approximately 40 paces. The last two numbers, i.e., "+03", "+21", etc., indicate the upper sampling depth in inches.

Nitrates were not detected above the method detection limit (<1.1 ppm) in any of the near-surface or shallow depth samples collected on license No. 24. The two sampling locations are positioned 40 and 80 paces, approximately 100 and 200 feet, respectively, north of the southern boundary of license No. 24. These locations were selected because they occur within the site of the last, or most recent waste cell operated on the license.

Minor levels of nitrates were detected in the 3-inch depth sample collected on the boundary ("BN") of the two licenses. Nitrates were not detected in the sample collected at the 12-inch depth.

On license 230 in the sample collected 40 paces (est. 100 feet) south of the "BN" location, nitrates were detected at concentrations of 7.7 and 10.5 ppm. Although the concentration is highest in the deeper sample, these results are inconclusive to suggest that vertical migration of nitrates may have occurred. The sample located 80 paces (est. 200 feet) south of the "BN" location did not detect nitrates in either the near-surface or shallow depth sample. Results from the samples collected on license No. 203 suggest that nitrate-containing materials, such as fertilizers, decomposing animal or plant cells, or sewage/livestock waste, may have been applied or disposed at or near sample location 203+40.

Nitrates were detected in all of the near-surface and shallow depth soil samples collected in the vicinity of the former surface water "ponding" site. Again, the results are inconclusive to: 1) determine if vertical leaching has or is occurring at the site, 2) to assess the nature and extent or level of nitrate-containing sediments deposited at the pond site, or 3) if the sediments are impacting groundwater in the vicinity of the landfill. Nitrate levels at the "P1" location, within the designated "ponding" site, range for 5.0 to 1.8 ppm. Approximately seven to ten feet higher, and up-slope, to the southwest, nitrate levels at the "P2" location range from 1.7 to 15.8 ppm. The latter result is the highest that was observed during this sampling effort.

The source of nitrates observed in the "P1" samples is suspected to have originated from runoff, transport, and deposition at the site. The nitrate-containing sediments at "P1" appear to be confined to the near-surface sediments. Currently, site drainage originates from licenses No. 24 and 203 and the rangeland to the north. Runoff from these areas commingle in the vicinity of the "ponding" site. Surface runoff no longer accumulates at the site; drainage continues to the southeast exiting license No. 203 midway between wells MW-2, 93MW-2D, and MW-1. The adjacent rangeland is currently used for cattle grazing. On several occasions, these cattle, and heavy accumulations of manure, have been observed throughout license 203 and in the immediate vicinity of well MW-2. Use of fertilizers on either the landfills or rangeland is not known.

Considering the distance and topographic differences between the "P1" and "P2" locations, the levels of nitrates detected in the "P2" samples are not believed to be an extension of that observed in "P1". The source of the "P2" nitrates is unknown considering that sewage sludge reportedly was not used as a soil amendment on license No. 203. Dried animal wastes were not observed in the vicinity of any of the sample location, especially "P2" and "203+40". However, animal waste cannot be ruled out entirely as a potential or partial source of the nitrates detected on license No. 203.

On license No. 24, nitrates were not detected; the materials containing nitrates which were reported to have been applied have apparently been taken-up by vegetation or removed by runoff. The former application of nitrate-containing materials as a source of nitrates in groundwater at well MW-2 or the pond site "P1" cannot be demonstrated with the data collected.

Recommendations:

Pursuant to MSWP letter dated February 1, the implementation of Assessment Monitoring at the landfill is required to be initiated before April 1, 1994. Previously, GeoResearch submitted a scope of work and cost estimate in the form of Tasks 7 and 8a to conduct the monitoring. These tasks were verbally authorized and subsequently deferred, pending the results of the soil tests presented above.

The preliminary results discussed above do not provide strong indications to suggest conclusively that significant nitrates are absent in the soils on license No. 203, and that they are not a potential contributing source of the nitrate concentrations detected in monitoring well MW-2. For the reasons expressed in our meeting of February 22, GeoResearch is in agreement with the City of Laurel and offers the following recommendations as the next step in determining the source(s) extent, and level of nitrates occurring in groundwater at the landfill. GeoResearch recommends:

- Installation of an additional monitoring well, MW94-1, located directly upgradient of MW-2 to replace well MW-4 as the background water quality well for license No. 203 and well MW-2. It is important to locate this well on license No. 24 to permit its usage as a background well and to comply with ARM 16.14.704 (i.e., "...well must be located...that has not been affected by leakage from the unit.").

- Install a second monitoring well, MW94-2, north and slightly upgradient of MW-2 on the adjacent rangeland. This well should provide the following information: 1) to assess if groundwater from the rangeland also contains nitrates and is a potential background source to MW-2, and 2) if 94MW-1 is clean of nitrates to assist in defining the nature and extent of the nitrate problem at the landfill. Determining nature and extent for assessing corrective action purposes is a future regulatory requirement which the landfill may anticipate should the results of assessment monitoring confirm concentrations of constituents in the groundwater in excess of background quality, enforcement standards, or preventative action limits.

- Sample and analyze both new wells for MSWP Table 1 constituents. The results for the listed constituents will then compare with those available for other wells at the landfill.

- Collect and analyze drill cutting (soil) samples for nitrates from the wellbores on five foot intervals from below the level of buried waste to the uppermost groundwater table.

- Inform MSWP of the intent to install additional monitoring wells and obtain its approval for the intended purpose and objectives of the wells. Request that MSWP temporarily defer implementation of assessment monitoring pending the evaluation and reporting of the groundwater results.

Cost of the Recommendations and Nitrates Study:

To assist the City of Laurel in planning and budgeting the investigations and activities associated with the landfill, GeoResearch has attached a proposed cost for installing the additional monitoring wells, Task 6b. The estimated costs incurred to conduct the soil sampling and testing for nitrates, Task 6A, have been included and identified separately for your formal authorization. Total cost for both tasks is estimated at $6,435 on a time-and-materials basis.

Authorization-to-Proceed:

If the City of Laurel is in agreement with the recommendations of this report, please signify its acceptance and authorization-to-proceed with Tasks 6a and 6b in accordance with the terms and conditions of the existing contract dated August 25, 1993. Please sign both copies of the Task Order and return one copy to GeoResearch. If you have any questions regarding the proposed activities, please do not hesitate to contact me.

Sincerely,

James D. Shaffer
Sr. Hydrogeologist

atch. Sample Location Map
Energy Labs Report #94-7312-25
Subtask Orders 6a and 6b

Acceptance of Terms, Conditions, and Costs:

CLIENT: City of Laurel	**CONSULTANT: GeoResearch, Inc.**
By: _____	By: _____
Name: _____	Name: James D. Shaffer
Title: _____	Title: Senior Hydrogeologist
Date: _____	Date: February 16, 1994

Authorization-to-Proceed:

Task 6a: _____

Task 6b: _____

GEORESEARCH, INC.

February 10, 1994

Ms. Pat Potts
Environmental Specialist
Montana Dept. of Health
and Environmental Sciences
Solid Waste Program
P. O. Box 200901
Helena, MT 59620-0901

Re: Transmittal of Draft Hydrogeological & Soils Study (1994),
City of Laurel Landfill (License #203), MT

Dear Ms. Potts:

Enclosed please find the required four copies of the subject Hydrogeologic Study (Study and Appendices volumes) which are submitted on behalf of the City of Laurel in accordance with the requirements of ACM 16.14.703. This study represents a compilation and reevaluation of the findings presented in the December 1992 study for this site and includes the results of investigations conducted by GeoResearch, Inc., during September to November 1993. Investigations conducted during that timeframe address the items required pursuant to your letters dated March 29, June 23, and July 8, 1993. The required copies of the Post-Closure Plan for the same facility have also been sent under separate cover to the Montana Solid Waste Program (MSWP) on February 3, 1994.

The City of Laurel requests that MSWP complete its review of the above reports at the earliest possible date. Upon receipt of your comments, we will provide the MSWP with additional explanation or clarification concerning the findings presented.

In accordance with previously applicable MSWP regulations, the results of groundwater monitoring and sampling to date, and the subject study completed in 1992, the MSWP letter of February 1, 1994 directed the City of Laurel to implement "assessment monitoring" of the five monitoring wells currently installed at the Landfill. Considering that the informational sources consulted to form the basis for the required monitoring were not entirely current, the City requests the MSWP to review the enclosed information and reevaluate its directives in light of this study and the Post-Closure Plan. Upon review and determination of anticipated changes in monitoring that may be warranted, the City requests a written response from MSWP which provides detailed statements, clarification, and regulatory citations for the following items identified in your February 1 letter:

115 North Broadway
Billings, MT 59101
TEL. (406) 248-6771
FAX (406) 248-6770

Ms. Pat Potts
Solid Waste Program
February 10, 1994

- Please identify, by statute, the "... exceeded US EPA and State regulatory MCL levels..." which are the "preventive action limits" or "enforcement standards" being imposed at the Laurel facility for nitrates. Also please provide the same information which may be applied for non-metals, metals, and VOCs.

- Citing of the previous regulation ARM 16.14.708(1) suggests that all, or part, of the previous regulations, i.e., pre-October 1993, may be applied by MSWP to address groundwater issues at this facility. Please clarify the regulations applicable to this facility.

- Explain the requirement for "assessment level monitoring" in 93MW-2D recognizing that the uppermost groundwater in this well is not the same as the groundwater bearing zone(s) completed in other facility wells.

- Clarify the regulatory requirement, ACM 16.14.708(1)(a)(ii), for sampling within 90 days versus the imposed 60-day resampling requirement as stated in your letter.

In anticipation of possible changes to MSWP February 1 letter, the City of Laurel anticipates deferral of sampling the five site monitoring wells prior to April 1, 1994. This action is pending upon receipt of further written instructions and/or confirmation of those items specified in the MSWP letter. Please direct copies of your responses to the attention of Mr. David Michael at the City of Laurel with a copy to GeoResearch, Inc.

Sincerely,

James D. Shaffer
Sr. Hydrogeologist

enc. (4) Draft Hydrogeologic & Soils Study

cc: C. Rodgers, Mayor, City of Laurel
D. Michael, City of Laurel

Laurel L.F. General Geol. Info.

3.2 REGIONAL GEOLOGY

The Cenex Laurel Refinery is located in Laurel, Montana near the north bank of the Yellowstone River. The Yellowstone River originates at the outlet of Yellowstone Lake in Yellowstone National Park and flows east-northeast a distance of approximately 400 miles before joining the Missouri River immediately east of the Montana-North Dakota state line. In the Laurel area, the Yellowstone River Valley is bound on the north by high cliffs capped by Cretaceous Eagle Sandstone and on the south by low hills underlain by the Colorado Shale. The uplands to the south of the Yellowstone River are known locally as the South Hills and are comprised predominantly of Cretaceous Colorado Shale. The uplands to the north of the Yellowstone River are known locally as the Rimrocks and are comprised of Upper Cretaceous Eagle Sandstone.

In the Laurel area, the Yellowstone River is incised into a series of shallow northeast-dipping Cretaceous shales, siltstones, and sandstones which represent a transition from deep marine to shallow water transgressive-regressive facies in late-Cretaceous time. The Cretaceous age sedimentary rocks exposed in the Laurel area represent a 5,000 foot thick sequence of shales and sandstones with a shallow 3° dip to the northeast. The exposed Cretaceous age sediments in this area, from older to younger, include the Colorado Shale, Telegraph Creek Formation, Eagle Sandstone, Claggett Shale, Judith River Formation, Bearpaw Shale, and Fox Hills Sandstone (Plate 3-2). Colorado Shale is exposed in the "South Hills" area south of the Yellowstone River as well as along the base of the "Rims" along the north side of the Yellowstone River. Telegraph Creek Formation is exposed between Eagle Sandstone and the Colorado Shale at the base of the "Rims". The Claggett Shale and younger Cretaceous age rocks are exposed in areas east-northeast of Billings. The lithologies encountered in Cretaceous and younger bedrock units in the Laurel area are summarized in Table 3-1.

The principal geologic structures in the Laurel area include the north-plunging Pryor Arch to the south, the Beartooth uplift to the southwest, the Reed Point Syncline and Crazy Mountain Basin to the west, and both the Lake Basin Anticline and Comanche Basin to the north. Four major fault zones have been identified in this area. These fault zones include the Lake Basin Fault zone to the north, the Fromberg Fault zone to the south-southwest, and the Beartooth fault zone and Nye-Bowler lineament to the southwest.

Unconsolidated sediments in this area consist of remnants of higher level Tertiary gravel terraces exposed west of the Billings area and Quaternary sediments exposed as slope wash, alluvial fan deposits, and alluvium associated with the Yellowstone River and its tributaries

TABLE 3-1

WATER-BEARING AND LITHOLOGIC CHARACTERISTICS OF GEOLOGIC UNITS

CENEX REFINERY
LAUREL, MONTANA

SYSTEM	SERIES	STRATIGRAPHIC UNIT	APPROXIMATE THICKNESS (feet)	LITHOLOGIC CHARACTERISTICS	WATER-BEARING CHARACTERISTICS
Quarternary	Holocene and Pleistocene	River-channel alluvium	0-20	Well-sorted sand and gravel; contains large cobbles. Silt and silty clay derived by erosion of Cretaceous rocks. Silt and silty clay derived by erosion of Cretaceous rocks. Silt and silty clay	Yields more than 50 gpm of good quality water to wells.
		Slopewash deposits	0-120		Yields small quantities (<1 gpm) of highly mineralized water.
		Alluvial-fan deposits	0-100(?)		Yields small quantities (<10 gpm) of highly mineralized water.
		Tributary alluvium	0-30		Yields small quantities (<10 gpm) of highly mineralized water.
Tertiary	Miocene to Pleistocene	Terraces on valley floor	0-60	Gravel and sand layers near the river grading to predominately silt at north edge of Terrace #3.	Yields 10-60 gpm to wells tapping gravel layers, silty layers yield very little water.
		High-terrace deposits	0-10	Well-sorted sand and gravel.	Usually lies above water table capping topographic highs.
Cretaceous	Upper Cretaceous	Judith River Formation	580	Alternating beds of yellow to brown sandstone and dark-gray shale.	Sandstone layers yield small quantities (<10 gpm) of water of fair quality to wells.
		Claggett Formation	620	Yellow-gray to light-brown fine-grained sandstone grading to siltstone and gray shale at the base.	May yield highly mineralized water.
		Eagle Sandstone	210	Light-yellow-brown fine-grained sandstone, massive at base and thin bedded at top.	Yields 5-10 gpm of water of fair quality to wells.
		Telegraph Creek Formation	160	Thin-bedded brown sandstone and shale.	Yields very little water (<10 gpm) to wells.
	Lower Cretaceous	Colorado Shale	2000-2500	Dark-gray to black shale; contains thin sandy members in the middle and lower sections.	May yield small quantities (<10 gpm) of highly mineralized water from sandy strata.
		Cloverly Formation	280	Thick basal sandstone, veriegated shale middle member, and sandy shale upper member.	Yeilds small quantities (<10 gpm) of highly mineralized water.

Reference: Gosling and Pashley (1973).

(Plate 3-2). At the base of the sandstone and shale cliffs either side of the Yellowstone River, silt and silty clays have accumulated as slope wash deposits. These deposits are reported to be approximately 909 feet thick at the base of the cliffs and thin rapidly towards the Yellowstone River (Gosling and Pashley, 1973).

Unconsolidated sediments along the Yellowstone River comprise three distinct terrace levels extending from west of Park City to just east of Billings a distance of approximately 30 miles. The three terraces have been designated T_1 through T_3 by Gosling and Pashley (1973). The T_1 Terrace is youngest of the three terraces and is found immediately adjacent to the Yellowstone River. This terrace is between 10 and 20 feet above the current river channel and consists primarily of 20 to 40 feet of coarse sand and gravels. The T_2 Terrace is between 10 to 20 feet above the T_1 Terrace and consists of 40 to 60 feet of sandy gravel with minor silt and clay. The T_3 Terrace is 30 to 50 feet above the T_2 Terrace and consists of up to 90 feet of silt and clay underlain by 20 to 30 feet of well washed gravels. The gravels in this terrace deposit thin to less than five feet in thickness at a distance of two miles from the base of the "Rims".

3.3 REGIONAL HYDROGEOLOGY

Limited regional hydrogeologic data have been published for the Laurel area. An evaluation of groundwater elevation data and groundwater quality parameters was conducted by Hutchinson (1983) for the period from 1968 through 1978. Data from this study indicated the Yellowstone River served as a regional discharge point for groundwater in shallow unconsolidated sediments during this period. The Billings area regional groundwater gradient in the unconsolidated aquifer was approximately 0.006 feet/feet. Groundwater flow was predominantly in a southerly to southeasterly direction in sediments north and east of the Yellowstone River. Groundwater flow south of the Yellowstone River was predominantly in a northeasterly direction generally parallel to the river. Groundwater contour data from Gosling and Pashley (1973) indicated the same groundwater flow directions existed previous to Hutchinson's (1983) study.

The primary aquifer in the Laurel area is the unconsolidated alluvium along the Yellowstone River. The Cretaceous sedimentary rocks present in this area generally yield less than 10 gallons per minute (gpm) of highly mineralized water. The Eagle Sandstone and Judith River Formation comprise the only viable bedrock aquifers in the area. Sandy zones in both the Colorado Shale and Claggett Shale are reported to yield very small quantities of highly

mineralized water in localized areas. However, the Colorado Shale serves as an aquitard in this region. The 1,600 to 2,500 feet of marine shale confine the underlying Dakota Sandstone aquifer. Water bearing properties of Cretaceous age and younger bedrock units have been summarized in Table 3-1.

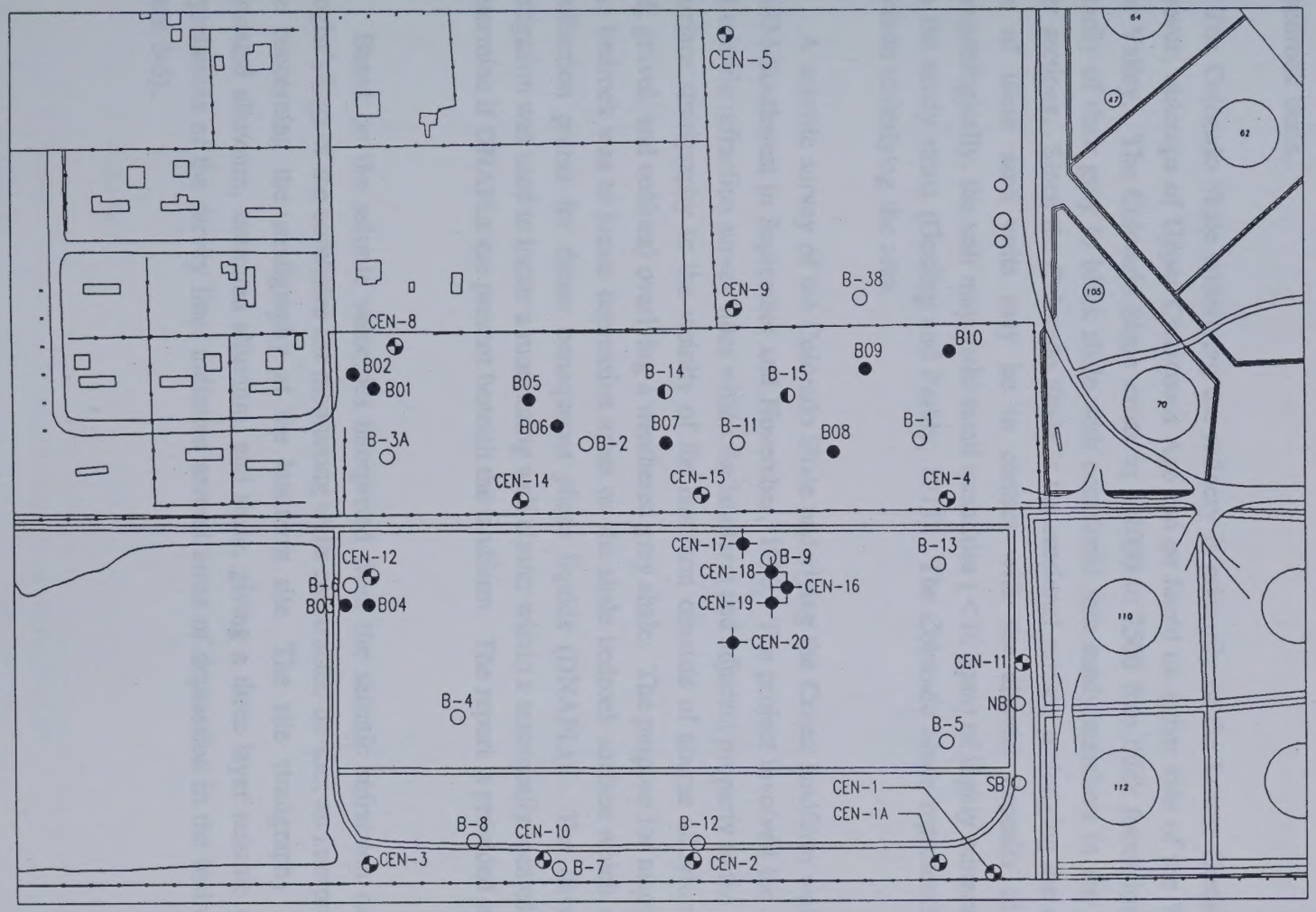
Water quality data presented by Hutchinson (1983) indicates specific conductance of groundwater in the study area was generally between 1000 and 3000 umhos/cm. Specific conductance highs were located along the outer margins of the Yellowstone Valley within the unconsolidated sediments. Specific conductance decreased to approximately 1000 umhos/cm moving towards the Yellowstone River. The higher specific conductance at the valley margins reflects a combination of lower recharge rates due to small recharge area and finer-grained sediments at the surface, as well as, discharge of groundwater with a higher specific conductance from adjacent bedrock units (Hutchinson, 1983). Groundwater in the unconsolidated sediments of the Yellowstone River valley at Billings contains dominant concentrations of sodium, magnesium, and sulfate dominated waters (Hutchinson, 1983).

3.4 FACILITY GEOLOGY

The geology at the Cenex Refinery has been described in studies conducted by E & E (1980, 1981), ERM-Southwest (1987, 1990, 1991), and Cenex (1985). A majority of the investigations have been focused on the refinery's landfarm located in the southwest corner of the refinery's property. From January 1981 through the present numerous borings and 17 monitoring wells, CEN-1A and CEN-1 through CEN-5, CEN-8 and CEN-12, CEN-14 through CEN-20 were completed in the landfarm and surrounding area (Figure 3-4). All available monitoring well, borehole, and test pit logs are provided in Appendix A. Cross sections developed from the borings are provided in Appendix B.

The Cenex Refinery is characterized by two stratigraphic units within 1000 feet of the ground surface: The Pleistocene river channel alluvium and the upper cretaceous Colorado bedrock shale (Ross, et. al., 1955).

The surface soils consist of clayey silt or disturbed sandy soil. Underlying the surface soil is a sandy pebbly gravel layer. This layer is characterized by fine to medium grained, angular moderately sorted sand with subrounded to rounded pebbles averaging 0.5 to 1.5 inches in diameter. Typically, it is present at depths between three and five feet in the landfarm area.



LEGEND

- MONITORING WELL
- ABANDONED WELL
- SOIL BORING, PART B PERMIT APPLICATION, 1985
- SOIL BORING, LTD, 1987
- SOIL BORING, LANDFARM CLOSURE, 1990

N

0 150 300

SCALE IN FEET

REV	BY	DATE	DESCRIPTION	CHK'D

DRAWN BY	J.J.C.
DATE	10/1/91
CHK'D BY	N.N.
DATE	10/28/91
SCALE	NOTED
CAD FILE	730/91A032

BORING LOCATIONS
CENEX REFINERY
LAUREL, MONTANA

REMEDIATION TECHNOLOGIES INC

FIGURE 3-4

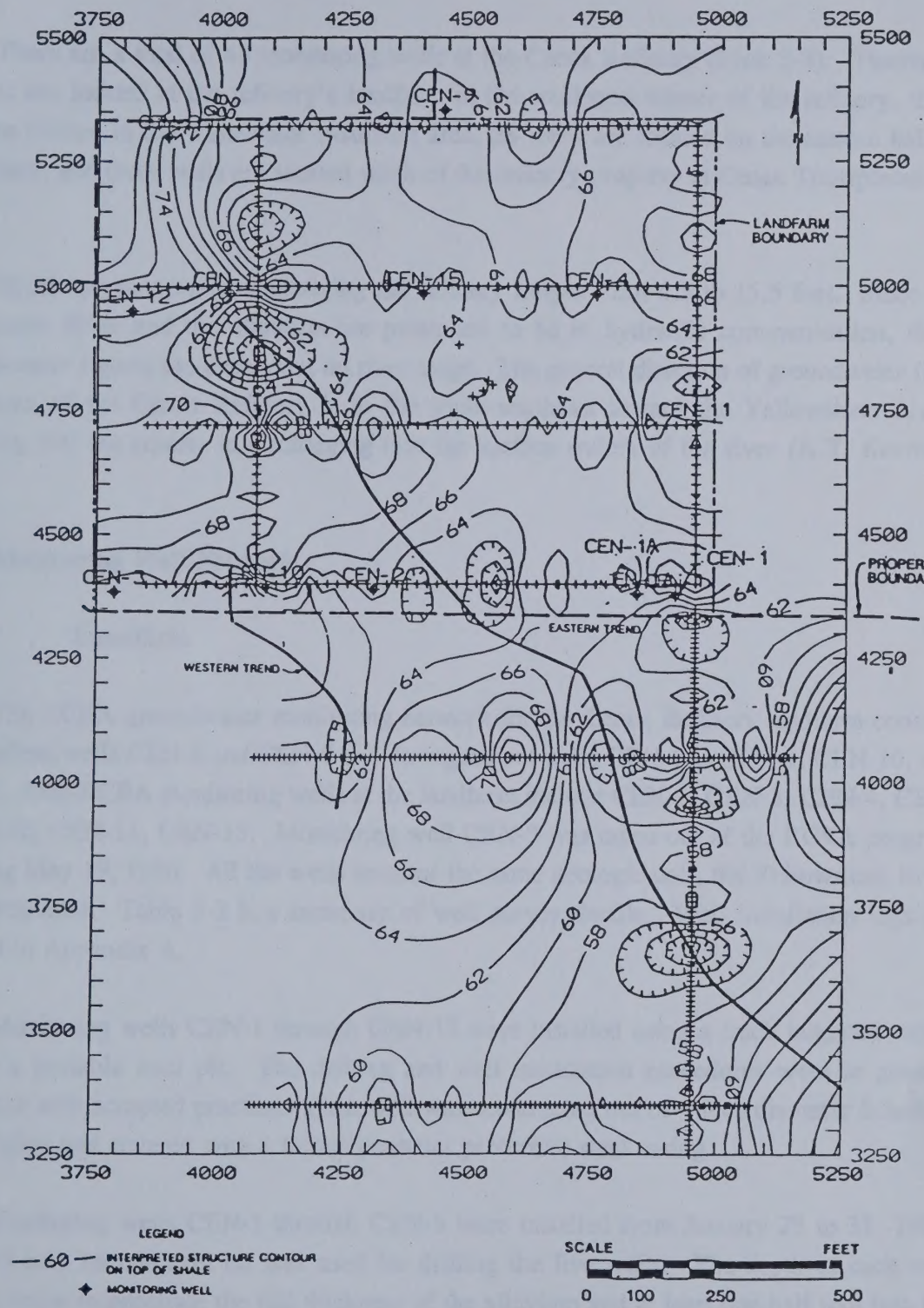
The gravel layer grades to a sandy cobbley gravel layer consisting of fine to coarse grained, subangular to angular well sorted sand with cobbles. The cobbles vary from three to seven inches in diameter, are rounded to well rounded and are igneous in origin with textures indicating episodes of metamorphic alteration. Locally the gravel/cobble zone occurs between the approximate depths of three and thirty feet. The base of this zone varies from about eighteen to thirty feet in depth and the gravel/cobble zone lies unconformably on the eroded surface of the bedrock shale.

The Colorado Shale underlying the refinery is primarily of the Lower Cretaceous Age. However, outcrops of Upper Cretaceous Age can be found on either side of the Yellowstone River Valley. The Colorado Shale exists as a 2000 to 2500 foot thick formation consisting primarily of dark gray to black shale with occasional thin sandy members in the middle and lower sections. Since the Colorado Shale is the erosional surface underlying the river valley some of these sand units may be in contact with the alluvial deposits of the area. Hydrogeologically, the unit may yield small quantities (< 10 gpm) of highly mineralized water from the sandy strata (Gosling and Pashly, 1973). The Colorado Shale represents a massive aquiclude underlying the area.

A seismic survey of the Colorado Shale underlying the Cenex landfarm was conducted by ERM-Southwest in September and November, 1990. The project involved the shooting of eight seismic refraction survey lines within the landfarm and adjacent property to the south. The subsurface stratigraphy in the vicinity of the landfarm consists of coarse alluvium sediments (sand, gravel, and cobbles) overlying a weathered grey shale. The purpose for mapping the top of the bedrock was to locate depression areas on the shale bedrock surface which might serve as collection points for dense nonaqueous phase liquids (DNAPLs). The data from this investigation was used to locate a monitoring well cluster within a seismically located depression to determine if DNAPLs are present beneath the landfarm. The report is provided in Appendix E.

Based on the seismic velocities interpreted from the seismic refraction data and the geologist's logs of the boreholes for monitoring wells constructed on-site, an interpretation was made concerning the stratigraphy at the landfarm site. The site stratigraphy consists of unsaturated alluvium, saturated alluvium, and shale, giving a three layer seismic model. The interpretations of the survey lines indicated several areas of depression in the bedrock surface (Figure 3-5).

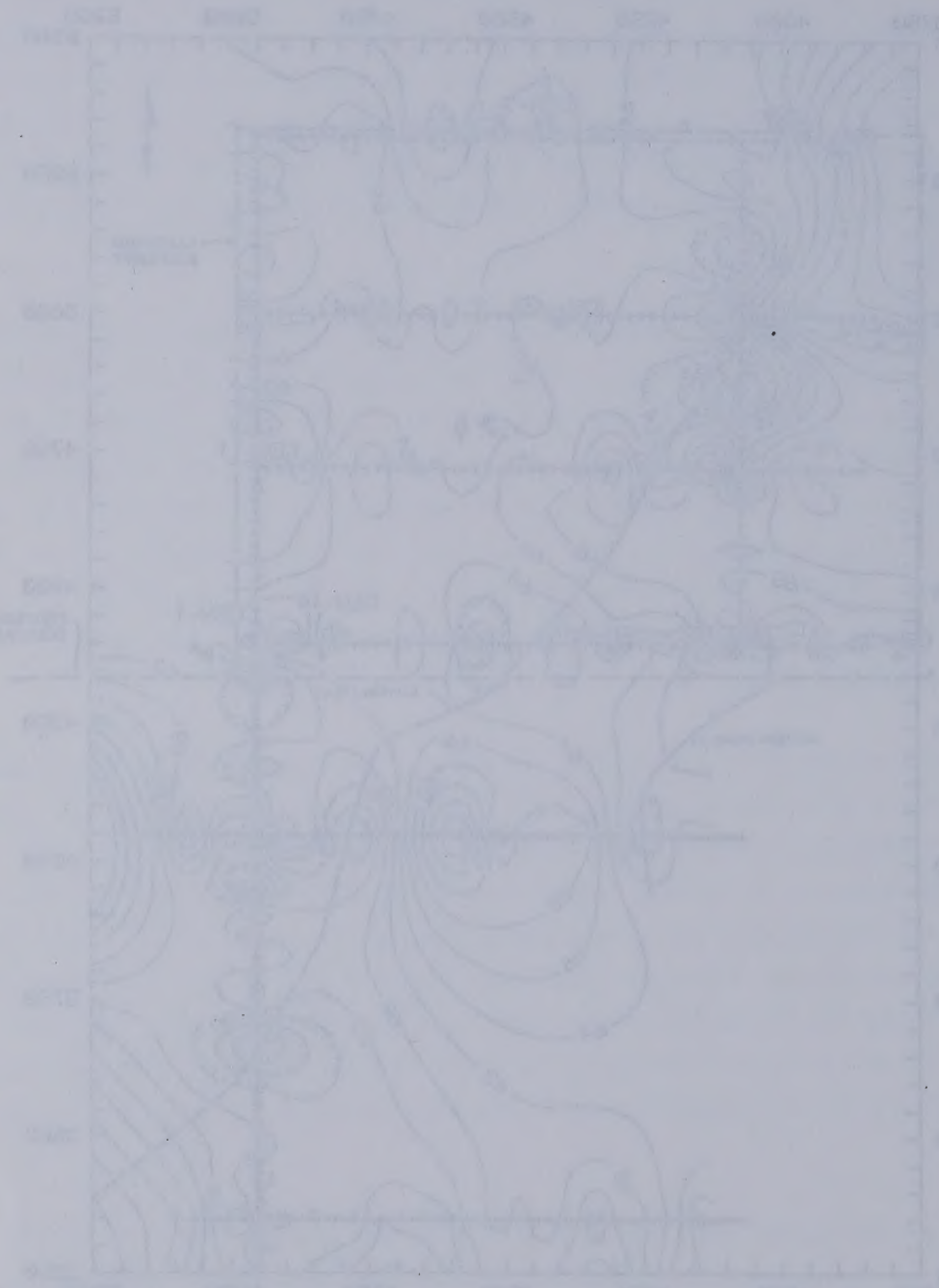
RETEC



from ERM - Southwest

Top of Shale Structure Contour Map as Inferred from Seismic Refraction Interpretations and Drilling Data Cenex Landfarm Site Laural, MT

FIGURE 3-5



3.5 FACILITY HYDROGEOLOGY

There are a total of 46 monitoring wells at the Cenex Refinery (Plate 3-3). Twelve of the wells are located at the refinery's landfarm in the southwest corner of the refinery, three wells are located in the wastewater treatment area, 28 wells are located on the eastern half of the refinery, and three wells are located south of the refinery property at Cenex Transportation, Inc.

Depth to groundwater underlying the refinery ranges from 4.5 to 15.5 feet. Since the Yellowstone River and the alluvium are presumed to be in hydraulic communication, these depth-to-water figures are dependent on river stage. The general direction of groundwater flow in the area of the Cenex Refinery is to the south-southeast toward the Yellowstone River, suggesting that the aquifer is discharging into the surface waters of the river (A.T. Kearney, 1987).

3.5.1 Monitoring Well Network

3.5.1.1 Landfarm

The RCRA groundwater monitoring network for the Cenex Refinery landfarm consists of upgradient wells CEN-8 and CEN-9 and downgradient wells CEN-1A, CEN-2, CEN-10, and CEN-11. Non-RCRA monitoring wells at the landfarm include CEN-1, CEN-3, CEN-4, CEN-5, CEN-12, CEN-14, CEN-15. Monitoring well CEN-3 was taken out of the RCRA program beginning May 19, 1986. All the wells monitor the same geologic unit, the Yellowstone River terrace alluvium. Table 3-2 is a summary of well survey details. Well installation logs are provided in Appendix A.

Monitoring wells CEN-1 through CEN-12 were installed using a truck mounted rotary rig with a portable mud pit. The drilling and well installation procedures were in general accordance with accepted practice. Each well was constructed out of 4-inch diameter Schedule 40 PVC pipe and covered with a 6-inch diameter protective steel casing.

Monitoring wells CEN-1 through CEN-5 were installed from January 28 to 31, 1981. A 7 - 7/8 inch tricone drill bit was used for drilling the five wells. The depth of each well varied in order to penetrate the full thickness of the alluvium and at least one-half foot into the underlying shale. Upon completion of drilling, a 4-inch Schedule 40 PVC well casing was